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WESTERN COMMITTEE
ON
CROP PESTS

1992 Report

WESTERN COMMITTEE ON CROP PESTS

Report of

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FOREWORD TO THE 1992 EDITION

The data presented in this report pertain to the four Western Canadian Provinces. The insecticides, rates and restrictions are current and represent, in the opinion of the Committee, the best recommendations available for the control of each pest. The report does not include all insecticides and rates registered in Canada for the purposes specified.

Only insecticides registered before 16 October 1991 are included. **Insecticides not registered** but otherwise acceptable to the Committee are listed in Appendix I of this report. **Registered insecticides** that, in the opinion of the Committee, require more efficacy data are included in Appendix II. Common names of insecticides are indexed with their trade names in Appendix III. The addresses of subcommittee chairmen are listed in Appendix IV.

Under pest species or groups in each section is an alphabetical listing of the insecticides registered for that pest. Insecticide rates indicated use the weight of active chemical ingredient (AI) unless otherwise stated. Preharvest intervals (PHI) are given in days.

Economic threshold information is included where available, even though the thresholds may be nominal (i.e. unsupported by research). Interactions among the numbers of insects, their stages of development, the stage and density of the crop, and weather conditions result in large variations in the amount of damage that can occur.

The Western Committee on Crop Pests meets annually to revise this report. The members represent Agriculture Canada, Environment Canada, Health & Welfare Canada, Departments of Agriculture of Manitoba, Saskatchewan, Alberta and British Columbia, Western universities, and the Crop Protection Institute of Canada. Technical advisers on pesticide registration also attend.

The information listed here is for the use of provincial and other agencies that issue recommendations for the control of insects and related pests of crop plants and plant products in commercial, domestic and public settings. Recommendations on livestock pests and plant diseases are provided by, respectively, the Western Committee on Livestock Pests and Western Committee on Plant Disease Control. This report supersedes previous reports and is valid for 1992 only.

J.W. Jones, Chairman
L.M. Dosdall, Secretary

30th annual WCCP meeting
Kelowna, British Columbia

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CEREAL CROPS AND GRAIN CORN

O.O. Olfert and D.L. Johnson

APHIDS

Aphids

Economic Thresholds -

Control not required except with greenbug, until numbers exceed 50/plant before heading. (2-4)

Corn leaf aphid - Heavy infestations on barley caused severe damage before boot stage but no effect if infested after the boot stage. (5)

English grain aphid - 70/head reduced kernel weights of wheat in the milk and early dough stages by 8%.Populations of aphids decreased rapidly as the heads matured. (1,5)

Bird cherry oat aphid carrying barley yellow dwarf virus reduced yields of dry forage and protein of oats and barley by over 50%. The viruliferous aphids reduced height of barley and oats, the number of tillers of barley, and the leaf width of oats. (2) Herta barley infected with barley yellow dwarf virus transmitted by grain aphids had an average loss of 65% in the weight of seeds per infected head. (3)

Greenbug - 20 to 30 aphids on seedling plants can reduce yield by as much as 60%. Higher populations can kill plants. Greenbugs inject toxin into plant. The toxin and feeding damage leaves, retard root growth, cause stunting, abnormal tillering, and improper filling of heads. (6)

Russian Wheat Aphid - Please refer to Appendix II, Cereal Crop Pests, Russian Wheat Aphid.

Chemical Control -

Active Ingredient	Rate (g AI/ha)	Preharvest Interval	References
BARLEY, OATS, RYE & WHEAT			
Demeton	210	45	1
Dimethoate	210	2	1
Malathion	700	7	5
CORN			
Malathion	1000-1400	5	-

Restrictions -

Malathion: Do not apply at air temperatures below 20°C.

Demeton: Do not use on rye

References -

1. Harper, J. Econ. Entomol. 66: 1326,1973.
2. Man. Dep. Agric., Pub. 227.
3. Minn. Dep. Agric., Minn. Pest Rep., 1976.
4. N. Dak. Dep. Agric., N. Dak. Pest Rep., 1977.
5. Wells and MacDonald, Can. J. Plant Sci. 41:866, 1961.
6. Kieckhefer and Kantack, J. Econ. Entomol. 73:582, 1980.

ARMYWORMS

Armyworm

Economic thresholds -

Control usually necessary when numbers exceed 10/m^2. (1)

Chemical Control -

Active Ingredient	Rate (g AI/ha)	Preharvest Interval	References
BARLEY, OATS AND WHEAT			
Carbaryl	1125-2250	14	2
Malathion	560-1400	7	2
Methomyl	340	20	2
Trichlorfon	560	21	2
RYE			
Carbaryl	1125-2250	14	2
Malathion	560-1400	7	2
CORN			
Methomyl	280-560	3	-

Restrictions -

Malathion: Do not apply at air temperatures below 20°C.

Methomyl: Apply to corn as soon as young larvae appear and then at 3 to 5 day intervals.

References -

1. Man. Dep. Agric., Pub 227.

2. Smith, Pest. Res. Rep., 1976:177.

BROWN WHEAT MITE

Brown wheat mite

Cultural Control -

Summerfallow; rotation with non-cereal crops.

Chemical Control -

Active Ingredient	Rate (g AI/ha)	Preharvest Interval	References
Chlorpyrifos	400	1	1

References -

1. Byers and Charnestski, Pest. Res. Rep. 1987 (In Press)

CUTWORMS

Cutworms: army, pale western, redbacked

Economic Thresholds -

Pale western cutworm at 8.4 larvae/m^2 caused 25% loss in wheat and at 30/m^2 caused 100% loss. Control is usually justified when larvae exceed 3-4/m^2. Economic thresholds for redbacked and army cutworm are somewhat higher at 5-6/m^2. Well established fall-seeded crops or spring seeded crops with good moisture conditions can tolerate higher numbers.

Cultural Control -

Reduce egg laying by pale western cutworm adults in summerfallow fields by destroying all plant growth in July and allowing field to crust until 15 September. Severely infested fields should be treated before reseeding. Attempts to starve the cutworms, particularly pale western cutworm, by delaying seeding often fail. In areas where redbacked cutworms are a problem, destroy weedy growth on fallow fields prior to August.

Chemical Control -

Active Ingredient	Rate (g AI/ha)	Preharvest Interval	References
Chlorpyrifos	420-560	60	1-6,8,9
Deltamethrin (EC)	10	40	3-6,8,9
Permethrin	70	7	1,2,6-9

Use low rates when larvae are small, high rates later in the season or under dry conditions. Apply in evening if possible. Rain following application is beneficial.

Restrictions -

Chlorpyrifos: Apply only once per season; do not apply to rye.
Deltamethrin: Do not graze fields. Apply only once per season for cutworms. Do not use at temperatures above 25°C.

References -

ARMY CUTWORM

1. McDonald, J. Econ. Entomol. 72:277, 1979.

PALE WESTERN CUTWORM

2. McDonald, J. Econ. Entomol. 74:45, 1981.
3. Wise et al., Pest. Res. Rep. 1982:183,184
4. Wise, Pest. Rep. 1983:174.
5. Wise, Pest. Rep. 1984:189.
6. Charnetski and Byers, Pest. Res. Rep. 1985:185.
7. Hill and Byers, Pest. Res. Rep. 1985:183,186.
8. Byers and Charnetski, Pest. Res. Rep. 1986:129.

REDBACKED CUTWORM

9. McDonald, J. Econ. Entomol. 74:593, 1981.

EUROPEAN CORN BORER

European corn borer

Economic Thresholds -

Economic loss will occur when 50% of dryland grain corn plants show signs of leaf feeding (shot-holing) by newly hatched larvae. This does not appear to be the case with irrigated grain corn.

Reference -

1. Anonymous, Agdex 605 - 622, Manitoba Agriculture.

GRASSHOPPERS

Grasshoppers
Economic Thresholds -

	No./m^2	
	Field	Roadside
Control not usually required	0 - 6	0 - 12
May be required	7 - 12	13 - 24
Control required	13+	25+

Two-striped grasshoppers at 5/m^2 from boot stage to maturity reduced yield of wheat by 25%. (6)

Ten grasshoppers/0.1 m^2 caged over wheat at 4-leaf stage destroyed the wheat in 72 hours. (4)

One grasshopper nymph/plant reduced yield by 25-44%. ll-27 /m^2 caused no damage, 45/m^2 caused 27-43% loss in cage tests (5); 8/m^2 clipped 20% of mature heads of wheat, and 16/m^2 reduced yields by 23%, 65%, and 62% in 1975. (l)

Cultural Control -

No tillage methods will provide crop protection but fall stubble cultivation is recommended. Destroying green growth on stubble in the spring at the time of grasshopper hatching may help to starve the young hoppers.

Chemical Control -

Active Ingredient	Rate (g AI/ha)	Preharvest Interval	References
Carbaryl (Sevin XLR)			
Barley, oats, wheat, rye	550-1125	14	-
Carbofuran			
Wheat, oats, barley	140	21	-
Corn	140	7	-
Chlorpyrifos: cereals			
Juveniles	280	60	13,14
Adults	420	60	5,6,7
Deltamethrin (EC)			
Aerial application	5-7.5	40	6,8
Ground Application	5-7.5	40	8
Deltamethrin (F)			
Aerial application	4-6	40	9-12
Ground application	4-6	40	-
Dimethoate (cereals only)			
Juveniles	210	2	4
Adults	420	21	4
Adults	490	28	-
Malathion			
Cereals & corn	840	7	-

Note: See Appendix II re: azinphos-methyl and methamidophos.

Restrictions -

Carbofuran:	Do not apply more than twice in one year on cereals.
Carbaryl (Sevin XLR):	Crop protection reduced under light canopy cover.
Deltamethrin:	Do not graze treated fields. Do not allow beef cattle to graze treated fields within 1 day of application. Do not feed treated silage to dairy cattle. Do not allow dairy cattle to graze treated fields. Do not make more than 3 applications per year (only two application per year by air). Do not use at temperatures above 25°C. Best control is obtained if application is made when the grasshoppers are in the 2 - 4 nymphal stage.
Malathion:	Do not apply at air temperatures below 20°C.

References -

1. Jacobson and Farstad, Can. Entomol. 73:158, 1941.
2. Man. Dep. Agric. Bull., Agdex 605.
3. Pickford and Mukerji, Can. Entomol. 106:1219, 1974.
4. Holmes et al., J. Econ. Entomol. 58:77, 1965.

5. Charnetski, Pest. Res. Rep. 1975:210.
6. McDonald, Pest. Res. Rep. 1974:7.
7. Rourke and Baudic Fehr, Pest. Res. Rep. 1985:171,176.
8. Stephen and Hagborg, Pest. Res. Rep. 1985:172.
9. Johnson et al., Pest. Res. Rep. 1985:174.
10. Reichardt et al., Pest. Res. Rep. 1986:124.
11. Stephen et. al., Pest. Res. Rep. 1986:148.
12. Wise and Scholtz, Pest. Res. Rep. 1986:149.
13. Mackasey et al., Pest. Res. Rep. 1986:147.
14. Rourke and Buth, Pest. Res. Rep. 1986:125.

HESSIAN FLY

Hessian Fly

Economic Threshold - Death of individual wheat and barley tillers or of the entire plant may result if numerous larvae are present (more than several per plant). "Flaxseed" puparia may be found at the base of plants.

Cultural Control -

Seed tolerant or resistant varieties (see reference 1). If possible, delay fall seeding.

Chemical Control - None.

References -

1. Maas et al. 1987. Crop Sci. 27:49-52.

ORANGE WHEAT BLOSSOM MIDGE

Orange wheat blossom midge

Damage - Infestations of 30, 60 and 90% reduced spring wheat yields by 40, 65 and 80% (3) (primarily Saskatchewan).

Cultural Control -

Seed alternate crops including barley. Farming practices which promote greater crop uniformity during heading and flowering (uniform seeding depth, higher seed rates to reduce tillering) reduce midge kernel damage but may not eliminate the need for chemical control.

Chemical Control -

Active Ingredient	Rate (g AI/ha)	Preharvest Interval	References
Carbofuran	140	21	2,3,5
Chlorpyrifos	400-480	60	2,3,5
Dimethoate	480	21	2,3,5

When applied 3 to 6 days after oviposition begins, chlorpyrifos provides ca. 20-30% better kernel protection than carbofuran or dimethoate. Sprays should be applied in the late afternoon or evening when temperatures exceed 15°C and the wind speed is less than 10 km/ha. To obtain full benefits from insecticidal sprays, thorough coverage of the wheat heads is essential. In general, application methods which improve the uniformity and amount of spray deposited on wheat heads (higher water volumes, finer spray droplets, 45° nozzle orientation) provide better kernel protection and subsequent grade or yield improvements. Use the higher rate of Lorsban 4E for aerial application, with water volumes of 20-35 L/ha.

References -

1. Dexter et al., 1987. Can. J. Plant Sci. 67:697-712.
2. Elliot, 1988a. Can. Ent. 120:615-626.
3. Elliott et at., 1985. Can. Ent. 117:593-598.
4. Olfert et al., 1985. Can. Ent. 117:593-598.
4. Wise and Leader, Pest. Res. Rep. 1985:181-182.
5. Sask. Ag. Midge Bull. 1988. 2 pp.

GRAIN STINK BUG

Grain Stink Bug

Economic Thresholds -

l/head of wheat causes losses exceeding 30%. (l)

Chemical Control -

Active Ingredient	Rate (g AI/ha)	Preharvest Interval	References
Dimethoate	275	21	2

References -

1. Jacobson, Cargill Crop. Bull. 15: 35, 1940.
2. Jacobson and McDonald, Pest. Res. Rep. 1964: 209.

THRIPS

Thrips on barley, oats, wheat & corn

Chemical Control -

Active Ingredient	Rate (g AI/ha)	Preharvest Interval	References
Dimethoate	470-500	21	-
Malathion	560	7	-

Restrictions -

Malathion: Do not apply at air temperatures below 20°C.

WHEAT STEM SAWFLY

Wheat stem sawfly

Economic Thresholds -

Control required if 10-15% of crop in previous year is cut by sawfly. Infested stems of wheat averaged 17% (11-22%) loss in yield. (1)

Cultural Control -

Seed Canuck, Leader, Lancer, or other resistant wheats, or immune crops such as oat and flax. Early swathing will reduce losses.

Chemical Control -

No insecticides recommended.

References -

1. Holmes, Can. Entomol. 109:1591, 1977

WIREWORMS

Wireworms on cereals & corn
Chemical Control -

Active Ingredient	Rate (g AI)	Preharvest Interval	References
Lindane (seed treatment)	0.5 g/kg grain	-	1,2
Terbufos 15G (corn only)	75g/100m row	-	3,6

Restrictions -

Lindane: Do not treat cereal seed if crop is to be used for forage. Do not mix treated seed with commercial grain. Do not allow poultry, livestock or wildlife to feed on treated seed.

CONSULT THE LABEL REGARDING STORAGE OF TREATED SEED.
Insecticide-treated seed can be stored for 1 year, but storage periods vary with seeds having DUAL TREATMENTS (insecticide-fungicide).

Store treated seed away from other grain and in such a manner that it cannot be eaten by domestic animals or wildlife. Apply seed dressing at the rate recommended on the label.

Terbufos: Minimum 75 cm row spacing.

References -

1. Burrage and Saha, Can. J. Plant Sci. 47:114, 1967.
2. Burrage and Gurba, Can. J. Plant Sci. 47:665, 1967.
3. Wilkinson, Pest. Res. Rep. 1974:188.
4. Wilkinson, Pest. Res. Rep. 1975:111.
5. Annette and Allan, Pest. Res. Rep. 1981:155.
6. Annette and Killins, Pest. Res. Rep. 1982:176.

OILSEED CROPS

I. Wise and L. Dosdall

Note: 1) See page 122 re: "Hazards and Safeguards - Crops in Bloom".
2) For aircraft application of soluble powders, use a minimum of 11 L water/ha.

ALFALFA LOOPER

Alfalfa Looper (canola)
Chemical Control -

Active Ingredient	Rate (g AI/ha)	Preharvest Interval	References
Chlorpyrifos	350-490	21	1-3
Methomyl	200-250	8	1-3

References -

1. Dolinski et al., Pest. Res. Rep. 1973:136.
2. Jacobson et al., Pest. Res. Rep. 1973:137.
3. McDonald, Pest, Res. Rep. 1973:252.

APHIDS

Aphids (canola and flax)
Economic Threshold -

Control of aphids in canola is rarely needed. Do not control aphids in flax unless populations exceed 10 aphids/plant (1).

Chemical Control - (canola only)

Apply to canola only if aphids are found in clusters on the flower stalks.

Active Ingredient	Rate (g AI/ha)	Preharvest Interval	References
Dimethoate	280-350	30	-

Reference -

1. Wise and Lamb, Agric. Can. Winnipeg, Res. Update 1990.

ARMY CUTWORM

Army Cutworm (canola and mustard)
Economic Threshold -
5/m^2 destroyed a mustard crop. (1)

Chemical Control -

Active Ingredient	Rate (g AI/ha)	Preharvest Interval	References
Chlorpyrifos	420-560	21	-

References -
1. Jacobson, J. Econ. Entomol. 55: 408, 1962.

BEET WEBWORM

Beet webworm (canola and flax)
Chemical Control -

Active Ingredient	Crop	Rate (g AI/ha)	Preharvest Interval	References
Methomyl		250	8	-
Trichlorfon	canola	420	21	1,2
	flax	420	21	-

Restrictions -
Trichlorfon: Do not apply to flax after flowering.

References -
1. Putnam, Pest. Res. Rep., 1962:126.
2. Putnam, Pest. Res. Rep., 1977:274.

BERTHA ARMYWORM

Bertha Armyworm (canola and flax)

Economic Thresholds -

Control usually necessary in canola and mustard when economic injury level is exceeded.

ECONOMIC INJURY LEVELS* FOR BERTHA ARMYWORM

		$ Value of Seed to Producer						
	$ / bushel:	6	7	8	9	10	11	12
	$ / tonne:	265	309	353	397	441	485	529
Cost of Spraying								
$/ac	$/ha	# Larvae / m^2						
7	17	20	17	15	13	12	11	10
8	20	23	20	17	15	14	13	11
9	22	26	22	19	17	16	14	13
10	25	29	25	22	19	17	16	14
11	27	32	27	24	21	19	17	16
12	30	34	30	26	23	21	19	17

* Based on an average of 20 larvae/sq m consuming the equivalent of 65 kg canola seed/ha (1.16 bushels/acre). These economic thresholds were developed using Argentine type canolas and therefore may not apply to Polish type canolas (10,11)

Chemical Control -

Active Ingredient	Rate (g AI/ha)	Preharvest Interval	References
Chlorpyrifos canola only	350-490	21	1,4-9
Deltamethrin canola & mustard	5-7.5	8	12-17
Methomyl	250	8	1-9
Methamidophos canola only	280-560	10	6-8

Restrictions -

Deltamethrin: Do not make more than three applications/yr. (Only one application/yr. by air. Do not apply at temperatures above 25°C.

References -

1. Putnam, Pest. Res. Rep. 1970:126.
2. McDonald et al., Pest. Res. Rep. 1971:177.
3. Peterson et al., Pest. Rep. Rep. 1971:143.
4. Lee et al., Can. Entomol. 104:1745, 1972.
5. Stewart, Pest. Res. Rep. 1972:166.
6. Jacobson et al., Pest. Res. Rep. 1972:172.
7. McDonald, Pest. Res. Rep. 1973:257.
8. Jacobson et al., Pest. Res. Rep. 1973:138.
9. Harris and Turnbull, Can. Entomol. 107:865, 1975.
10. Bracken and Bucher, J. Econ. Entomol. 70:701, 1971.
11. Bracken and Bucher, Rep. Canola Council of Canada,1981.
12. Derksen and Blouw, Pest. Res. Rep. 1980:121, 122, 123.
13. McVicar and MacKenzie, Pest. Res. Rep. 1980:124.
14. McVicar and Makowski, Pest. Res. Rep. 1980:125.
15. Wise and Kitson, Pest. Res. Rep. 1980:128.
16. Wise and McVicar, Pest. Res. Rep. 1980:129, 130.
17. Wise, McVicar and Kitson, Pest Res. Rep. 1980:131.

CLOVER CUTWORM

Clover cutworm (canola)

Chemical Control -

Active Ingredient	Rate (g AI/ha)	Preharvest Interval	References
Methomyl	250	8	1
Deltamethrin	5-7.5	8	2-5

References -

1. Dixon, Pest. Res. Rep. 1971:176.
2. Catellier & Wise, Pest. Res. Rep. 1982:99.
3. Catellier & Wise, Pest. Res. Rep. 1982:100.
4. McDonald, Pest. Res. Rep. 1975:260.
5. McDonald, Pest. Res. Rep. 1979:354.

CUTWORMS: PALE WESTERN & REDBACKED

Cutworms: Pale western & redbacked on canola, flax & sunflowers

Cultural Control -

In summerfallow fields, to prevent egg laying by pale western cutworm adults, destroy all plant growth in July and allow summerfallow to crust until September 15. In areas where redbacked adults are present, avoid weedy growth in August and weedy patches in crops. Starve young cutworm larvae before spring seeding by allowing volunteer growth to reach 2-5 cm before cultivation, then delay seeding 10-14 days.

Chemical Control -

Active Ingredient	Rate (g AI/ha)	Preharvest Interval	References
Chlorpyrifos			
canola	425-560	21	1-5
flax (redbacked cutworm)	425-560	21	1-5
sunflower	560	90	1,2,4,5
Deltamethrin			
flax	10	40	6,7

Restrictions -

Deltamethrin: Do not make more than 3 applications/yr. (Only one application/yr by air). Do not apply at temperatures above 25°C.

References -

1. McDonald, J. Econ. Entomol. 62:30, 1968;65:533, 1972.
2. Askew et al., Pest. Res. Rep. 1973:151.
3. McDonald, Pest. Res. Rep. 1974:251.
4. Askew et al., Pest Res. Rep. 1974:244.
5. Philip and Dolinski, Pest. Res. Rep.1977:215.
6. McVicar and Wise, Pest. Res. Rep. 1982:113.
7. Wise and Long, Pest. Res. Rep. 1985:95.

DIAMONDBACK MOTH

Diamondback moth (canola & mustard)

Economic Thresholds -

Control not required in canola until larvae exceed 200-300/m^2.(3,4) Threshold may be lower for Polish type canolas than for Argentine type canolas (4).

Chemical Control -

Active Ingredient	Rate (g AI/ha)	Preharvest Interval	References
Azinphos-methyl canola	300	0	1,2
Deltamethrin	5 - 7.5	8	5
Malathion	350	7	1
Methidathion canola	250	30	-
Trichlorfon canola	1120	21	1,2

Restrictions -

Deltamethrin: Do not make more than three applications/yr. (Only one application/yr. by air).Do not apply at temperatures above 25°C.

Malathion: Do not apply at air temperatures below 20°C.

Methidathion: Do not feed or allow animals to graze on treated crops. Apply in minimum of 110 L water/ha by ground; or 22 L water/ha by air. Do not apply when bees are present.

References -

1. Putnam, Pest. Res. Rep. 1962:126.
2. Putnam, Pest. Res. Rep. 1974:10 (re: possible resistance to insecticides).
3. Putnam, Agric. Can., Saskatoon, unpublished, 1976.
4. Harris, Sask. Agric., Regina, Sask. 1990.
5. Wise and Leader, Res. Rep. 1985:84,85.

FLAX BOLLWORM

Flax bollworm
Chemical Control -

Active Ingredient	Rate (g AI/ha)	Preharvest Interval	References
Methomyl	250	8	1

References -

1. Putnam, Pest. Res. Rep. 1974:180.

FLEA BEETLES

Flea beetles (canola & mustard)
Chemical Control -

In-Furrow and Seed-Coating Treatments

These recommendations are for seed-drill application and are not valid for application with discer seeders.

Active Ingredient	Rate (g AI/ha)	Rate (g AI/kg seed)	References
Carbofuran (granular)	225-280	35-56	1-12
Lindane (seed dressing)	16 g/kg	16	1,3-9,11,12
Terbufos (granular)*	280-560	35-112	1-4,11-17

* Mix granules with seed.

Note - The lindane treatment may have to be followed by a foliar spray 7 - 14 days after seedling emergence.

Foliar Sprays

Active Ingredient	Rate (g AI/ha)	Preharvest Interval	References
BEFORE POD FORMATION:			
Azinphos-methyl (canola)	70	30	1,3-5,8,12
Carbaryl (canola)	540	-	-
Carbofuran (canola)	70-140	60	1,4,8,10,12
(mustard)	70-140	21	-
Cypermethrin	35	30	20
Deltamethrin	5-7.5	8	19
Malathion (canola & mustard)	560	7	4
Methidathion (canola & mustard)	175	30	1,4,12
AFTER POD FORMATION:			
Malathion	560	7	-

Restrictions -

Azinphos-methyl: Do not apply when bees are foraging.

Carbaryl: Apply only up to 4 weeks after seedling emergence.

Carbofuran: Do not apply at 70 g/ha more than twice to the same crop, nor at the 140-g rate more than once.

Cypermethrin: Avoid application at temperatures above 27°C. Only one application per year by air.

Deltamethrin: Do not feed treated crop to livestock. Do not apply at temperatures above 25°C. Do not make more than 3 applications/yr. (Only one application/yr. by air).

Malathion: Do not apply at air temperatures below20°C. Do not apply when bees are foraging.

Methidathion: Do not feed or allow animals to graze on treated crops.
Apply in minimum of 110 L water/ha by ground; or 22 L water/ha by air.

Note: Yellow mustard seedlings are substantially resistant to flea beetle attack and should not require treatments with insecticides at seeding.

References -

1. Putnam, Pest. Res. Rep. 1970:128; 1973:174; 1975:166; 1976:132; 1977:147.
2. Swailes et al., Pest. Res. Rep. 1972:122; 1974:233.
3. Swailes and McDonald, Pest. Res. Rep. 1974:134.
4. Askew et al., Pest Res. Rep. 1974:226,228; 1976:127,129,131; 1977:144.
5. Palmer, Pest. Res. Rep. 1974:229; 1975:164.
6. Smith et al., Pest. Res. Rep. 1974:231.
7. Kolach and Bell, Pest. Res. Rep. 1975:161.
8. Westdal et al., Pest. Res. Rep. 1976:134,136.
9. Philip et al., Pest. Res. Rep. 1977:145.
10. Romanow et al., Pest. Res. Rep. 1977:151.
11. Westdal et al., Pest. Res. Rep. 1977:153,155; 1978:257; 1979:195; 1980:112.
12. Putnam, Can. J. Plant Sci. 57:987, 1977.
13. Volkers and Allison, Pest Res. Rep. 1979:203,208.
14. Philip and Steiner, Pest. Res. Rep. 1979:206.
15. Drew, Pest. Res. Rep. 1979:211; 1980:133.
16. Kneeshaw and Smith, Pest. Res. Rep. 1979:211; 1980:133.
17. Kneeshaw et al., Pest. Res. Rep. 1980:81.
18. Westdal et al., Pest. Res. Rep. 1980:115.
19. McVicar and Farnsworth, Pest. Res. Rep. 1982:97.
20. Romanow and Askew, Pest. Res. Rep., 1982:84, 1983:83.

GRASSHOPPERS

Grasshoppers

Cultural Control -

Tillage methods do not provide crop protection but fall stubble cultivation is recommended. Destroying green growth on stubble in the spring at the time of grasshopper hatching may help to starve young hoppers.

Chemical Control -

Active Ingredient	Crop	Rate (g AI/ha)	Preharvest Interval	References
Carbofuran	canola	140	60	1,2
	flax, mustard & sunflower	140	21	1,2
Malathion	canola, flax & mustard	840	7	1
Methamidophos	canola	600	10	-

Bee pastures: Do not apply when bees are present.

Carbofuran: Do not apply more than once per season.

Malathion: Do not apply at air temperatures below 20°C.

References -

1. Charnetski, Pest. Res. Rep. 1975:210.
2. McDonald, Pest. Res. Rep. 1975:248.

PAINTED LADY BUTTERFLY

Painted lady butterfly
Chemical Control -

Active Ingredient	Rate (g AI/ha)	Preharvest Interval	References
Methidathion	525-700	50	1

Restrictions -

Methidathion: Do not feed or allow animals to graze on treated crops.

References -

1. Schulz, N.D. Agric. Exp. Sta., unpublished.

RED TURNIP BEETLE

Red turnip beetle

Cultural Control -

The eggs are dropped on the soil late in the summer, beneath canola or related plants. They hatch in the spring and the grubs feed on volunteer canola or winter annual weeds such as flixweed and mustards. Destruction of these food plants while the pest is still in the early grub stage may starve larvae. Adults are mobile.

Chemical Control -

Active Ingredient	Crop	Rate (g AI/ha)	Preharvest Interval	References
Azinphos-methyl	canola	140-200	30	1-4
Carbofuran	canola mustard	140 140	60 21	3,4 -
Methidathion	canola & mustard	260	30	3,4

Restrictions -

Carbofuran: Do not apply more than once per season.

Methidathion: Do not feed or allow animals to graze on treated crops. Apply in minimum of 110 L water/ha by ground or 22 L water/ha by air.

References -

1. Bowden, Pest. Res. Rep. 1972:123.
2. Dolinski and Philip, Pest. Res. Rep. 1972:165.
3. Westdal et al., Pest. Res. Rep. 1974:225.
4. Dolinski et al., Pest. Res. Rep. 1975:159.

SUNFLOWER BEETLE

Sunflower beetle

Economic Thresholds -

Control required with l adult/2-3 seedlings or over 10 larvae/plant. (l,3,10) Severe leaf damage may occur to plants in the 2 to 6 leaf stage when adults are numerous, and on growing plants throughout the season when larvae are numerous.

Chemical Control -

Active Ingredient	Rate (g AI/ha)	Preharvest Interval	References
Azinphos-methyl	280	-	2,4,7-9
Carbofuran larvae adults	70 140	60 60	8 7,8
Cypermethrin	25	70	2,13
Endosulfan	560	60	1,3,5-7
Methidathion	260-525	50	6-8
Deltamethrin	5-7.5	70	ll

Restrictions -

Do not apply insecticides after plants are 60 cm high or after heads begin to form.

Azinphos-methyl: Do not apply more than twice per season, 7-14 days apart.

Carbofuran: Do not apply more than 280 g/season. Do not apply by aircraft.

Cypermethrin: Avoid application at temperatures above 27°C. Only one application by air.

Endosulfan: Do not apply more than once per season. Do not feed treated foliage to livestock.

Methidathion: Do not feed or allow animals to graze on treated crops.

Deltamethrin: Do not make more than three applications/yr. (Only one application by air.) Do not apply at temperatures above 25°C.

References -

1. Kolach, Pest. Res. Rep. 1970:147.
2. Bergen et al., Pest. Res. Rep. 1972:138.
3. Kolach et al., Pest. Res. Rep. 1972:141.
4. Bowden, Pest. Res. Rep. 1973:156.
5. Palmer and Todd, Pest. Res. Rep. 1973:157.
6. Zirk and Donaghy, Pest. Res. Rep. 1973:158, 1974:247.
7. Askew et al., Pest. Res. Rep. 1974:245.
8. Westdal et al., Pest. Res. Rep. 1974:246.
9. Palmer, Pest. Res. Rep. 1975:181.
10. Man. Dep. Agric., Pub. 277.
ll. Westdal et al., Pest. Res. Rep. 1981:130.
12. Romanow and Askew, Pest. Res. Rep. 1983:144.
13. Emilson, Pest. Res. Rep. 1983:141,142,143; 1984:160,161,162,163.

SUNFLOWER MAGGOTS

Sunflower maggots
Economic Threshold - None established.

Chemical Control -

Active Ingredient	Rate (g AI/ha)	Preharvest Interval	References
methidathion	525 - 700	50	-

Restrictions - Do not feed or allow livestock to graze on treated crops.

Notes - Insecticide use has not been warranted for control of sunflower maggot.

SUNFLOWER MIDGE

Sunflower Midge
Economic Threshold -

Destruction of seeds and distortion of heads can cause serious losses in fields in the Red River Valley of Manitoba. Losses are more severe around field edges. Losses can be estimated by sampling heads and classifying them by the degree of head cupping and the relative area of seed destroyed (1).

Cultural Control -

Where significant losses occur, growers should plant resistant varieties in subsequent years. Among currently registered varieties, some are resistant and many are highly susceptible.

Chemical Control -

No chemical control is feasible because the larvae feed within the head.

Reference -

1. Bracken, Can. J. Plant Sci. 71: 81-85.

SUNFLOWER SEED WEEVILS

Red & grey Sunflower seed weevils

Economic Threshold -

Oil sunflower: 10 - 12 seed weevil adults/head.

Confectionery sunflower: One adult/head.

Optimal Treatment Timing: Early anthesis, when 30 - 70% of sunflower heads are in early pollen formation, i.e. R-5.1 stage (for example, when 3 - 7/10 plants show ray petals and at least one row of disc flowers). Reinfestation of the field may occur in areas with a high weevil population. Fields should be rechecked when 80 - 100% of heads are at the R-5.5 stage.

Chemical Control -

Active Ingredient	Rate (g AI/ha)	Preharvest Interval	References
chlorpyrifos	575	42	-
cypermethrin	28	70	-

Note: Apply in minimum 20 L water/ha either by ground or air.

Reference -

1. N. Dakota State Univ. Coop. Ext. Serv. Publ. #E-817.

FORAGE CROPS

B.D. Schaber & M. Okuda

ALFALFA WEEVIL

Alfalfa weevil

Economic Thresholds

Alfalfa hay crops (6-9)

- 25-50% of leaves on the upper one-third of the stem show damage (6)
- 50-70% of terminals show injury (9)

Alfalfa seed Crops (10)

- 20-25 larvae/sweep (90°=straight sweep)
- 35-50% of foliage tips show damage

Cultural Control -

Cut the first hay crop early. If damage reappears in new growth, treat with insecticides immediately.

Chemical Control -

Active Ingredient	Rate (g AI/ha)	Preharvest Interval	References
Azinphos-methyl APM or Guthion 50WP	560 - 840 1.1–1.75 kg/ha	21 Guthion SC 2.25–3.5 L/ha	1,2
Carbofuran Furadan 480F	260 550 ml/ha	7	3,6
Deltamethrin (seed crop only) Decis 2.5E	12.5 400–500 ml/ha	-	12,13
Malathion 50 EC	1000 - 1400 2–3 L/ha	7	1,2
Methidathion Supracide 250 EC	280 - 560 1.1–2.25 L/ha	10	4,5
Methoxychlor 50WP	1125 - 1400 2.25–2.75 kg/ha	7	1
Phosmet Imidan 50WP	1125 2.25 kg/ha	7	-

Forage Crop: If application is made to heavy growth, 110-220 L water/ha may be required for adequate coverage.

Seed Crop: For least hazard to bees use methoxychlor or deltamethrin. Hold leafcutter bees off the crop for at least 12 hours after methoxychlor application, or at least 24 hours after deltamethrin application.

Restrictions -

Crop in bloom:	Do not apply insecticide when bees are pollinating. See page 122 regarding hazard to bees.
Azinphos-methyl:	Do not apply more than once per cutting. Do not apply within 21 days of grazing or harvesting for forage.
Carbofuran:	Do not apply more than once per season.
Deltamethrin:	For use on seed crops only; do not feed treated crops to animals; one application per year. Do not apply by aircraft.
Malathion:	Do not apply at air temperatures below 20°C.
Methidathion:	Do not feed or allow animals to graze on treated crops.
Phosmet:	Do not apply more than once per cutting.

References -

1. Bass and Knapp, J. Econ. Entomol. 59:648, 1966.
2. Swailes and McDonald, Pest. Res. Rep. 1964:177.
3. Ellis, Pest. Res. Rep. 1976:167.
4. Richards and Charnetski, Pest. Res. Rep. 1976:168.
5. Harper, Can. Entomol. 110:891, 1978.
6. Bereza, Ontario Agdex 121/622. 4 pp., 1977.
7. Hastings and Pepper, J. Econ. Entomol. 46:785, 1953.
8. Hintz et al., J. Econ. Entomol. 69:749, 1976.
9. Carpenter, J. Econ. Entomol. 63: 1602, 1970
10. Johansen, Pacific North West Ext. Publ. No. 128, 1980.
11. Charnetski and Schaber, Pest. Res. Pep. 1980:160.
12. Charnetski, Pest. Res. Rep. 1983:154.

BROMEGRASS SEED MIDGE

Bromegrass seed midge

Cultural Control -

Thorough burning of stubble and trash before regrowth in late summer, or in early spring, provides some, but not complete, control. (1-2)

References -

1. Neuman and Manglitz, Agric. Exp. Sta., Univ. Neb., Res. Bull. 252, 1972.
2. Knowles, Forage Notes 18(2), 1973; 19(2), 1974.

GRASSHOPPERS

Grasshoppers (alfalfa, clover & grasses)
Economic Thresholds - (See Cereal Crops, page 5)

Chemical Control -

Active Ingredient	Crop	Rate (g AI/ha)	Preharvest Interval	References
Azinphos-methyl	alfalfa, clover	260 - 420	21	-
*Carbaryl		550 - 1125	0	-
Carbofuran	alfalfa	140	1	4
	grass (pastures)	140	1	-
	sweet clover	140	28	-
Deltamethrin	rangeland	5 - 7.5		
Dimethoate		210 - 420	2 - 7	1 - 4
Dimethoate(bait)		110 - 165	0	5
Malathion		840	7	-

*Data from XLR formulation.

Restrictions -

Crop in bloom: See page 122 regarding hazard to bees.

Azinphos-methyl: Do not apply more than once per cutting. Do not apply within 21 days of grazing or harvesting for forage.

Carbaryl (XLR): Dilutions of higher than l:ll are not recommended when residual insect control from the wash-off resistance is desired.

Carbofuran: Do not apply to pastures within l day of grazing or to sweet clover within 28 days, or alfalfa within l day of harvest or grazing, or sunflowers more than 60 cm high or heads forming. Do not apply more than twice per season.

Dimethoate: Standing crops treated with 210 mL of dimethoate should not be grazed by dairy cattle until 2 days after treatment and with 420 mL. Do not graze or harvest within 7 days.

Malathion: Do not apply at air temperatures below 20°C. Standing crops treated with malathion may be grazed immediately after treatment.

References -

1. Holmes et al., J. Econ. Entomol. 58:77, 1965.
2. Banham, Pest. Res. Rep. 1964:134.
3. McDonald and McKinlay, Pest. Res. Rep. 1964:132.
4. Dolinski and Boisvert, Pest. Res. Rep. 1973:185.
5. Mukerji, et al., Can. Ent. 1981:707.

PEA APHID

Pea aphid (alfalfa)

Economic Thresholds -

1430 aphids/sweep did not reduce the forage yield of alfalfa. (2)

Caged alfalfa initially infested with 100-200 aphids/plant produced less forage and had lower carotene contents than uninfested plants. (4)

Cultural Control -

On irrigated alfalfa, control may be unnecessary if adequate water is provided to the plants. (2)

Chemical Control -

Active Ingredient	Rate (g AI/ha)	Preharvest Interval	References
Deltamethrin	7.5 - 10	-	-
Demeton (for hay)	280 - 325	21	-
Dimethoate	210	2	1, 3
Malathion	700	7	1 - 3
Methidathion	280 - 560	10	1, 3

Note: Use 90-110 L water/ha to ensure thorough coverage. Treat if population is large enough to stunt plants or if heavily infested hay is to be dehydrated.

Restrictions -

Do not apply when pollinators are present. See page 122 re: hazard to bees.

Dimethoate: Do not graze or harvest alfalfa treated with dimethoate within 2 days of application.

Malathion: Do not apply when air temperature is below 20°C.

Methidathion: Do not feed or allow animals to graze on treated crops.

References -

1. Harper, Can. Entomol. 110:891, 1978.
2. Hobbs et al., Can. Entomol. 93:801, 1961.
3. McDonald and Harper, Can. Entomol. 110:213, 1978.
4. Harper and Lilly, J. Econ. Entomol. 59:1426, 1966.

PLANT BUGS

Plant bugs in alfalfa seed fields: Alfalfa plant bug, Superb plant bug, Lygus bugs and Plagiognathus bug.

Economic Thresholds -

5 nymphs/sweep of any or all species of plant bugs, when the alfalfa is in bud or in bloom. (7-9)

Cultural Control -

Burning of alfalfa stubble and debris in early spring controls all species except lygus bugs. (3,5,15)

Chemical Control -

Active Ingredient	Rate (g AI/ha)	Preharvest Interval	References
Deltamethrin	10	-	10 - 14
Dimethoate	560	28	1, 6
Methidathion	280 - 560	10	6, 14
Trichlorfon	1155	14	1, 2, 4, 14

Note: In burned fields for control of lygus bugs, apply dimethoate, methidathion or deltamethrin just before the alfalfa begins to bloom. Wait 7 days after applying dimethoate or methidathion; and wait 1 full day after applying deltamethrin before putting or replacing leafcutter bees on the crop.

In unburned fields for control of all plant bugs, apply dimethoate or methidathion when flowerbuds are beginning to form.

If the alfalfa is in bloom and bees are in the crop, apply trichlorfon in late evening when bees are not foraging. This treatment is not recommended for the Peace River Region of Alberta.

Restrictions -

Deltamethrin: Do not feed treated crop to animals; apply only once/yr.; do not apply by air.

References -

1. Craig, Pest. Res. Rep. 1971:167.
2. Kolach and Senkow, Pest. Res. Rep. 1972:151.
3. Lilly and Hobbs, Can. J. Plant Sci. 42:53, 1962.
4. Craig, Pest. Res. Rep. 1973:168.
5. Craig, Agric. Can. Pub. 1935, 1973.
6. Harper, Can. Entomol. 110:891, 1978.
7. Craig and Lasiuk, Pest. Res. Rep. 1971:167.
8. McMahon, Rep. B.C. Agron. Assoc. 1950:58.
9. Sorenson, Utah Agric. Exp. Sta.,Bull. 284,1939.

10. Charnetski and Schaber, Pest. Res. Rep. 1980:161.
11. Charnetski, Pest. Res. Rep. 1983:154.
12. Butts, Pest. Res. Rep. 1981:149; 1983:156.
13. Butts and Lippert, Pest. Res. Rep. 1982:166.
14. Cattellier and Wise, Pest. Res. Rep. 1982:167.
15. Schaber and Entz, Journ. Econ. Entomol. 81:668-672, 1987.

RED CLOVER THRIPS

Red clover thrips (red clover seed fields)

Economic Thresholds -

Damage insignificant unless 50-80 thrips/raceme are present. (l) Threshold levels only occur during years of early spring drought on dryland.

Reference -

l. Craig, unpublished data 1987, Saskatoon.

SWEET CLOVER WEEVIL

Sweet clover weevil

Economic Thresholds (7) -

In seedling sweet clover crops:

l weevil adult/5 seedlings in cotyledon stage under slow growth conditions.

l weevil adult/3 seedlings in cotyledon stage under normal growth conditions.

In newly emerging 2nd year sweet clover:

9-12 weevil adults/plant.

Cultural Control -

Seedling stands:

Locate new seedlings as far as possible from 2nd-year clover.

First-year stands in late summer:

Defoliation of lst-year clover by close-cutting, grazing, or weevil feeding during the critical period of mid-August to mid-September will severely reduce 2nd-year yield. Swath companion grain crops high.

Second-year stands:

2nd-year clover will usually outgrow weevil damage; insecticide application is rarely necessary. Sweet clover silage and hay fields should be cultivated as soon as possible after the crop is taken; this kills the new- generation weevil larvae in the soil. (6,7)

Chemical Control - **In sweet clover seedling crops**

Active Ingredient	Rate (g AI/ha)	Preharvest Interval	References
Azinphos-methyl	420	21	2 - 4
Carbaryl	1125	1	2, 3
Dimethoate	560	28	1 - 4

Apply insecticide when the very young seedlings are noticeably damaged by weevil feeding.

In lst-year clover in late summer and fall:

Dimethoate	560	28	1
Malathion	700	N/A	5

Apply insecticide to crop margins where weevils are concentrated. Use malathion if the clover will be grazed or cut and fed or use dimethoate if not grazed or fed.

In 2nd-year crops:

Dimethoate	560	28	5

Restrictions -

Azinphos-methyl: Do not apply more than once per cutting. Do not apply within 21 days of grazing or harvesting for forage.

Dimethoate: Do not apply within 28 days of grazing or harvesting for forage.

Malathion: Do not apply at air temperatures below 20°C. Dairy cattle should be removed when spraying but may be returned immediately.

References -

1. Craig, Pest. Res. Rep. 1971:179.
2. Craig, Pest. Res. Rep. 1964:136.
3. Craig, Pest. Res. Rep. 1965:135.
4. Swailes and McDonald, J. Econ. Entomol. 58:988, 1965.
5. Craig, Pest. Res. Rep. 1968: 150.
6. Bird, 80th Annual Rep., Entomol. Soc. Ont., 1949.
7. Craig, Can. Entomol. 110:883, 1978.

SPECIAL CROPS

J.W. Jones and W.J. Turnock

ALFALFA LOOPER

Alfalfa looper

Chemical Control -

Crop	Active Ingredient	Rate (g AI/ha)	Preharvest Interval	References
Peas	methomyl	195 - 520	1	-
Soybean	naled	950 - 1900	4	-
Vetches	naled	1000 - 1750	4	-

Restrictions -

Naled: Do not apply when temperature is over 32°C. Do not graze within 4 days of application.

Methomyl: Do not graze livestock within 10 days.

APHIDS

Aphids

Economic Threshold -

Canary Grass: More than 50 per head between heading and soft dough.

Field Peas: 9-12 aphids/sweep or 2-3 aphids/20 cm stem tip when 50% of plants have produced some young pods. (4)

Chemical Control -

Crop	Active Ingredient	Rate (g AI/ha)	Preharvest Interval	References
Canary grass	dimethoate	240	21	-
	malathion	700	14	-
Dry beans	azinphos-methyl (EC & WP)	425 - 550	-	
	azinphos-methyl (dust)	525 - 675	3	-
	dimethoate	340 - 500	7	-
	naled	950 - 1900	4	-
Peas	dimethoate	130 - 205	3	1
	disulfoton	1080 - 2340*	60	-
	malathion	875 - 1125	3	-
	methomyl	195 - 520	1	-
	naled	950 - 1900	4	-
	pirimicarb	75 - 140	6	2, 3

Crop	Active Ingredient	Rate (g AI/ha)	Preharvest Interval	References
Safflower**	oxydemeton-methyl	420 - 540	-	-
Vetches**	azinphos-methyl	540 - 675	-	-
	naled	950 - 1900	4	-
Soybeans	naled	1000 - 1750	4	-

* for 75 cm row spacing (or use 75 - 145 g AI/1000 m row for other row spacings). Do not place disulfoton-treated zones (bands or furrows) closer together than 15 cm.
** seed crop only; not for feed or forage.

Restrictions -

azinphos-methyl: Do not feed treated forage. Do not graze treated area within 21 days of application. Do not treat food crops grown in greenhouses or other crops used for food or forage.

dimethoate: Do not feed or allow livestock to graze treated pea vines within 21 days after application. Do not apply foliar sprays during the heat of the day when temperatures are exceedingly high. Do not graze or feed treated bean forage to livestock.

disulfoton: Do not exceed the 2340 g ai/ha rate. Do not use as foliar spray. Do not apply more than once per season.

methomyl: Do not graze livestock for 10 days after treatment.

naled: Do not apply when temperature is over 32°C.

pirimicarb: Use at least 17 litres water per ha when applied by aircraft. Use higher rate when aphid population is high or when weather is very cool.

Notes -

dimethoate: May be applied by air or ground equipment.

disulfoton: Can be sprayed or injected into the furrow at planting time, or injected as a soil-dress treatment after plants become established.

CAUTION - At maximum rates under adverse conditions such as extremely cool, dry, or wet weather may cause some delay in emergence, stunting of seedlings or reduction of stand. Effects may be more pronounced in light sandy soils. Plant injury may also occur or be enhanced when certain pre-emergence herbicides are used in conjunction with disulfoton.

References -

1. Wise, Pest. Res. Rep. 1988: 82
2. Moons, Pest. Res. Rep. 1987: 91
3. Baillargeon, Pest. Res. Rep. 1978: 193
4. Maiteki and Lamb, J.Econ. Ent. 1985: 1449.

LEAFMINERS

Beet leafminer and other unspecified leafminers

Economic Thresholds -

Sugar beet - Only infestations causing more than 25% defoliation require treatment. (1)

Chemical Control -

Crop	Active Ingredient	Rate (g AI/ha)	Preharvest Interval	References
Sugar beet	trichlorfon	630 - 1155	14	1,2,3
Dry beans	azinphos-methyl	425 - 550	3	-
	dimethoate	340 - 500	7	-

Notes -

dimethoate: Consult fieldman before treating.

Restrictions -

trichlorfon: Treated tops should not be fed within 28 days of treatment.
dimethoate: Do not graze treated forage or feed to livestock.

References -

1. Lilly, Pest. Res. Rep., 1970:142.
2. Lilly and Bergen, Pest. Res. Rep. 1970:142.
3. Lilly and Harper, J. Amer. Soc. Sugar Beet Technol. 12:192,1962.

BEET WEBWORM and BEET ARMYWORM

Beet Webworm and Beet Armyworm

Chemical Control -

Crop	Active Ingredient	Rate (g AI/ha)	Preharvest Interval	References
Sugar Beet				
(beet armyworm)	trichlorfon	1155 - 1800	14	-
(beet webworm)	trichlorfon	280 - 630	14	1, 2

Restrictions - Tops harvested less than 28 days after treatment should not be fed to livestock.

Notes - Use lower rate when applied by row crop sprayers and higher rate for low volume or aircraft sprayers.

References -

1. McDonald, J. Econ. Entomol. 56:248,1963.
2. Chemagro Corp. (Kansas City). Tech. Data Bull., 1961.

BLISTER BEETLES

Blister beetles
Chemical Control -

Crop	Active Ingredient	Rate (g AI/ha)	Preharvest Interval	References
Vetches	parathion	265 - 480	-	-

Restrictions - Do not apply when bees are foraging.

CUCUMBER BEETLES

Cucumber beetles: Striped cucumber beetle & Spotted cucumber beetle
Chemical Control -

Crop	Active Ingredient	Rate (g AI/ha)	Preharvest Interval	References
Dry beans	azinphos-methyl	550	3	-

CUTWORMS

Cutworms: Army cutworm, Darksided cutworm, Pale western cutworm, Redbacked cutworm, Variegated cutworm & White cutworm
Chemical Control -

Crop	Active Ingredient	Rate (g AI/ha)	Preharvest Interval	References
Lentils, peas	permethrin	110 - 150	-	-
Sugar beets	chlorpyrifos (pale western & redbacked only)	575 - 1150	90	1,2
	permethrin	70 - 150	90	-
	trichlorfon (variegated cutworm)	560 - 1200	14	-
Sunflower	chlorpyrifos (army, pale western & redbacked)	560 - 575	90	-
	permethrin (army, black, darksided, pale western, redbacked & white cutworms)	110 - 150	90	-

Restrictions -

Chlorpyrifos: Apply once per season in 50 - 220 L water/ha at seedling stage (4 to 5 leaf stage).

Trichlorfon: Tops harvested less than 21 days after treatment should not be fed to livestock.

Use lower rate when applying by row crop sprayer, higher rate for low volume or aircraft application.

Note -

Permethrin: Use the high rate when the soil surface is extremely dry, when cutworms are nearing maturity or the infestation is heavy. Apply in the evening or at night when cutworms are most active. Do not disturb soil surface for 5 days after treatment.

References -

1. Allen and Askew, Pest. Res. Rep. 1971:154.
2. Askew et al., Pest. Res. Rep. 1973:151.

FLEA BEETLES

Flea Beetles

Chemical Control -

Crop	Active Ingredient	Rate (g AI/ha)	Preharvest Interval	References
Sugar Beet	azinphos-methyl	67	30	-
	azinphos-methyl	75	100	-
	malathion	560	-	-
Sunflower	azinphos-methyl	75	30	-

Restrictions - Sugar Beet

azinphos-methyl: Do not apply more than once per season.

malathion: Do not apply at air temperatures below 20°C.

Note -

azinphos-methyl: Use minimum 100 litres water/ha.

malathion: Use 90 - 225 L water/ha.

GRASSHOPPERS

Grasshoppers

Economic Threshold -

Safflower: More than 15/m^2

Chemical Control -

Crop	Active Ingredient	Rate (g AI/ha)	Preharvest Interval	References
Lentils	deltamethrin (F)	4 - 6	40	-
	deltamethrin (EC)	5 - 7.5	40	-
Safflower	dimethoate	265 - 480	21	-
Sunflower	carbofuran	130	60	-

Restrictions -

deltamethrin: Do not feed treated straw or crop residue to livestock. Do not graze treated fields. Do not apply more than 3 times per year. Apply not more than twice per year by air.

Ground Application: Use 100 - 200 L water/ha. Do not apply if temperature exceeds 28°C.

Aerial Application: Use 11-22 litres of water per ha. Do not apply more than 2 times per year. Do not apply when wind exceeds 8 km/h (5 mph). Use high rate only.

carbofuran: Not more than 2 applications per season. Do not spray after plants are more than 60 cm tall or after heads have started to form. Use not less than 100 L water/ha.

Notes -

deltamethrin: Best control achieved when grasshoppers in the 2 - 4 nymph stages. Observe buffer zone around sensitive areas: 100 m. when applying by air, 15 m. when applying by ground.

dimethoate: Not more than 2 applications/year. Do not apply foliar sprays when air temperatures are exceedingly high.

LEAFHOPPERS

Leafhoppers

Chemical Control -

Crop	Active Ingredient	Rate (g AI/ha)	Preharvest Interval	References
Dry beans	azinphos-methyl	550	3	2
	dimethoate	340 - 500	-	-
	disulfoton	1080 - 2340*	-	-
Dry beans, peas, vetches	methoxychlor	110 - 225	7	-
Dry beans, peas, vetches	naled	654 - 1145	4	-

* for 75 cm row spacing (or use 75 - 145 g AI/1000 m row for other row spacings). Do not place disulfoton-treated zones (bands or furrows) closer together than 15 cm.

Restrictions -

dimethoate: Do not graze or feed treated forage to livestock.

disulfoton: Do not exceed the 3.25 L/ha rate. Do not use as foliar spray. Do not apply more than once per season.

methoxychlor: Do not feed pea foliage to livestock.

naled: Do not apply when air temperature is over 32°C.

Notes -

disulfoton: Can be sprayed or injected into the furrow at planting time, or injected as a soil-dress treatment after plants become established.

CAUTION - At maximum rates under adverse conditions such as extremely cool, dry or wet weather may cause some delay in emergence, stunting of seedlings or reduction of stand. Effects may be more pronounced in light sandy soils. Plant injury may also occur or be enhanced when certain pre-emergence herbicides are used in conjunction with disulfoton.

References -

1. Whitfield et al., Pest. Res. Rep. 1976: 178
2. Whitfield and Ellis, Pest. Res. Rep. 1976: 180

LEAFROLLERS

Leafrollers

Chemical Control -

Crop	Active Ingredient	Rate (g AI/ha)	Preharvest Interval	References
Dry beans	azinphos-methyl (EC & WP)	275 - 550	3	-
	azinphos-methyl	525 - 675	3	-

Restrictions -

azinphos-methyl: Do not feed crop residue to livestock. Do not graze treated forage.

PEA WEEVIL

Pea weevil
Chemical Control -

Crop	Active Ingredient	Rate (g AI/ha)	Preharvest Interval	References
Peas	methoxychlor	800 - 2300	7	-

Restrictions -

Methoxychlor: Do not feed foliage to livestock.

ROOT MAGGOTS

Seedcorn and bean seed maggots (*Delia* spp.); sugarbeet root maggot
Chemical Control -

Crop	Chemical	Rate (g AI/100 kg seed)	Preharvest Interval	References
		Seed Treatments		
Soybean	diazinon & lindane	30 - 35 50 - 55		6,7

Crop	Chemical	Rate (g AI/ha)	Preharvest Interval	References
		Band Treatments		
Sugarbeet	aldicarb	1100	90	2
	terbufos	1100		2
		Drench Treatment		
	carbofuran	1100	120	-

Restrictions -

aldicarb: Do not apply within 120 days of harvest if tops are to be fed to livestock. Do not use tops as food for humans.Do not apply within 120 days of harvest if tops are to be fed to livestock; do not use tops as food for humans.

carbofuran: Do not use on fields subject to flooding (waterfowl feeding on treated fields may be killed).

diazinon & lindane: Do not use on seed already treated with an insecticide. Do not store treated seed more than three months. Apply only in conjunction with or over a fungicidal treatment. Allow seed to dry before bagging.

terbufos: Do not place in direct contact with seed. Apply 5-8 cm behind seed crop zone after some soil has covered the seed.

Notes -

Soybean: For best results seed should be planted within a week after treatment. Seed may be treated with diazinon alone or in combination with lindane or lindane + captan.

Sugarbeet: Apply drench treatment in 200 L water/ha over the row followed by a light irrigation.

References -

1. Askew et al., Pest Res. Rep. 1976: 145
2. Askew et al., Pest Res. Rep. 1977: 183
3. Askew et al., Pest Res. Rep. 1978: 135
4. Askew et al., Pest Res. Rep. 1979: 100
5. Lilly, Pest Res. Rep. 1975: 179
6. Schaafsma, Pest Res. Rep. 1987: 156
7. Schaafsma, Pest Res. Rep. 1988: 53
8. Whitfield & Bergen, Pest Res. Rep. 1984: 159
9. Whitfield & Bergen, Pest Res. Rep. 1985: 132

SPIDER MITES

Spider mites

Chemical Control -

Crop	Active Ingredient	Rate (g AI/ha)	Preharvest Interval	References
Dry beans	disulfoton	1080 - 2340*	60	-
	azinphos-methyl (dust)	525 - 675	3	-
	azinphos-methyl (EC & WP)	300 - 540	3	-
Soybeans	naled	1000 - 1750	4	-

* for 75 cm row spacing (or use 75 - 145 g AI/1000 m row for other row spacings). Do not place disulfoton-treated zones (bands or furrows) closer together than 15 cm.

Restrictions:

disulfoton: Do not exceed the 3.25 L/ha rate. Do not use as foliar spray. Do not apply more than once per season.

naled: Do not apply when air temperature is over 32°C.

Notes -

disulfoton: Can be sprayed or injected into the furrow at planting time, or injected as a soil-dress treatment after plants become established.

CAUTION -

At maximum rates under adverse conditions such as extremely cool, dry or wet weather may cause some delay in emergence, stunting of seedlings or reduction of stand. Effects may be more pronounced in light sandy soils. Plant injury may also occur or be enhanced when certain pre-emergence herbicides are used in conjunction with disulfoton.

SUGARBEET ROOT APHID

Sugarbeet root aphid

Cultural Control -

Maintain fertility, irrigate early and frequently. No satisfactory chemical control is available.

Reference -

1. Harper, J. Econ. Entomol. 54:6, 1961.

TARNISHED PLANT BUG

Tarnished plant bug and other *Lygus* spp.

Chemical Control -

Crop	Active Ingredient	Rate (g AI/ha)	Preharvest Interval	References
Dry bean	dimethoate	340 - 500	7	-

Restrictions - Dimethoate: Do not graze or feed treated forage to livestock.

THRIPS

Thrips

Chemical Control -

Crop	Active Ingredient	Rate (g AI/ha)	Preharvest Interval	References
Dry bean	disulfoton	1080 - 2340*	60	-

* for 75 cm row spacing (or use 75 - 145 g AI/1000 m row for other row spacings). Do not place disulfoton-treated zones (bands or furrows) closer together than 15 cm.

Restrictions - Do not plant disulfoton-treated zones. Do not exceed the 3.25 L/ha rate. Do not use as foliar spray. Do not apply more than once per season.

Notes - Can be sprayed or injected into the furrow at planting time, or injected as a soil-dress treatment after plants become established.

CAUTION - At maximum rates under adverse conditions, such as extremely cool, dry, or wet weather, disulfoton may cause some delay in emergence, stunting of seedlings or reduction of stand. Effects may be more pronounced in light sandy soils. Plant injury may also occur or be enhanced when certain pre-emergence herbicides are used in conjunction with disulfoton.

VETCH BRUCHID

Vetch bruchid
Chemical Control -

Crop	Active Ingredient	Rate (g AI/ha)	Preharvest Interval	References
Vetch	azinphos-methyl (dust)	825	-	-
	azinphos-methyl (EC & WP)	550	-	-

Restrictions -
azinphos-methyl: Do not feed crop residue to livestock. Do not feed treated forage.

WIREWORMS

Wireworms
Chemical Control -

Crop	Active Ingredient	Rate (g AI/100 kg seed)	References
		Seed Treatments	
Pea	lindane	50	1
Soybean	diazinon	30 - 35	-
	lindane	50 - 55	-
Sugar Beet	lindane	165	-

Crop	Active Ingredient	Rate (g AI/1000 m row)	References
		Band Treatment	
Sugar Beet	terbufos	67.5	2

Restrictions -

Soybean: Do not store seed treated with lindane longer than one month. Do not use on seed already treated with an insecticide. Apply only in conjunction with or over a fungicidal treatment.

Sugar Beet: Do not apply by aircraft. Do not place in direct contact with seed. Do not apply later than at planting.

Notes -

Soybean: Formulations for wireworm control contain either lindane alone or in combination with diazinon and captan. Formulations vary; seed may require dry or slurry treatment.

Sugar Beet:

lindane - when used as a dual-purpose seed treatment of the grain crop in the year preceeding planting of sugar beets, lindane has been more effective for wireworm control than treatment of sugar beet seed alone.

terbufos - tops and beet pulp may be fed to livestock after harvest. Apply in furrow at planting time 5-8 cm behind the seed drop zone after some soil has covered the seed.

References -

1. Smith, Pest. Res. Rep. 1985:100
2. Lilly, Pest. Res. Rep. 1978:137

HOUSEHOLD PESTS

M. Steiner and L. Harris

Homeowners are advised to purchase ready-to-use products. Use only those products labelled specifically for households. **Do not substitute those labelled only for gardens.**

ANTS

Ants

Chemical Control -

	Rate
*Bendiocarb	0.125-0.25% in water or 1% dust
*Chlordane (carpenter ants)	2% spray or 5% dust
*Chlorpyrifos EC	0.25-0.50% spray
Chlorpyrifos (0.5% ready-to-use solution)	50 mL/m^2
Diazinon	0.5% coarse aerosol or 1% spray or 2% dust
*Diazinon (encapsulated)	0.5-1% spray
Propoxur	0.5-1% spray
*Pyrethrins (encapsulated)	0.25% spray
Resmethrin	0.25% spray

*Commercial use only.

Restrictions -

Avoid contamination of food, feedstuffs, and water supplies.

References -

1. Agric. Can., Pub. 1736/E.

BEDBUGS

Bed bugs

Chemical Control -

	Rate
*Bendiocarb	0.25% in water or 1% dust
*Malathion (premium grade)	0.5% on mattresses and upholstery, 2% spray elsewhere
Pyrethrins	0.25-0.5% spray

*Commercial use only.

References -

1. Agric. Can., Pub. 1736/E.

BOXELDER BUG

Boxelder bug

Chemical Control -	Rate
Methoxychlor (with pyrethrin and piperonyl butoxide)	aerosol - follow label
*Trichlorfon SN	1.25 g/L

*Commercial use only.

Restrictions -

Avoid contamination of food, feedstuffs, and other supplies.

References -

1. Mazurek et al., Proc. Entomol. Soc. Ont. 92:202,1961.

CARPET BEETLE

Carpet beetle

Chemical Control -	Rate
*Bendiocarb	0.25% in water or 1% dust
*Chlorpyrifos EC	0.25-0.5% spray
Chlorpyrifos (0.5% ready-to-use solution)	50 mL/m^2
*Diazinon (encapsulated)	0.5% spray
Diazinon	0.5-1% spray
*Malathion (premium grade)	3% spray
Methoxychlor (with pyrethrin and piperonyl butoxide)	aerosol - follow label
Propoxur	0.5-1% spray
*Pyrethrins (encapsulated)	0.08-0.22% spray

*Commercial use only.

Restrictions -

Avoid contamination of food, feedstuffs, and water supplies.

References -

1. B.C. Entomol. Circ. 20, 1962.
2. Agric. Can., Pub. 1202, 1974.
3. Robinson, Manitoba, personal observations.

CENTIPEDES and MILLIPEDES

Centipedes and Millipedes

Chemical Control -	Rate
*Bendiocarb	0.25% in water or 1% dust
Carbaryl (outdoors)	1-2% spray or 5% dust
Diazinon	0.5%-1% spray
Malathion (outdoors)	3% spray
Propoxur (outdoors)	1% spray-to surface of buildings
*Pyrethrins (encapsulated)	0.08-0.22% spray
Resmethrin	0.25% spray

*Commercial use only.

Restrictions -

Avoid contamination of food, feedstuffs, and water supplies.

References -

1. Agric. Can. Publ. 1736/E.
2. Mallis, Handbook of Pest Control, 1969.

CLOTHES MOTHS

Clothes moths

Chemical Control -	Rate
*Bendiocarb	0.25% in water or 1% dust
Diazinon	0.5-1% spray
*Malathion (premium grade)	3% spray
Methoxychlor	2-3% pressurized spray
Propoxur	0.5-1% spray
*Pyrethrins (encapsulated)	0.08-0.22% spray

*Commercial use only.

Restrictions -

Bendiocarb: Do not apply to clothing.

References -

1. Agric. Can., Pub. 1736/E.

CLOVER MITE

Clover mite

Chemical Control -	**Rate**
*Diazinon (encapsulated)	0.5% spray
Diazinon 12% EC	7.8 mL/L
Dicofol 18.5% EC	7.8 mL/L
Malathion 50% EC (outdoors)	23 mL/L
Methoxychlor (with pyrethrin and piperonyl butoxide)	aerosol - follow label
Propoxur	0.5-1% spray

*Commercial use only.

Apply sprays to grass and outside walls. Use vacuum cleaner indoors. Grass-free barrier of 45-60 cm next to house is effective means of preventing invasion.

Restrictions -

Avoid contamination of food, feedstuffs, and water supplies.
Propoxur: Use indoors, not on vegetation.

References -

1. English and Snetzinger, J. Econ. Entomol. 50:135, 1957.
2. MacNay, Agric. Can., Pub. 934, 1963.

COCKROACHES

Cockroaches

Chemical Control -	**Rate**
*Bendiocarb	1% dust
*Chlorpyrifos EC	0.25-0.5% spray
Chlorpyrifos (0.5% ready-to-use solution)	50 mL/m^2
*Diazinon (encapsulated)	0.25% spray (maintenance treatment) 0.5%-1% spray (cleanout treatment)
Diazinon	0.5% spray or 2% dust
*Malathion (premium grade)	2% spray or 4% dust
Methoxychlor (with pyrethrin and piperonyl butoxide)	aerosol - follow label
Propoxur	1% spray
*Pyrethrins (encapsulated)	0.08-0.22% spray
Resmethrin	0.25% spray

*Ronnel (with synergized pyrethrins)	1-1.5% spray
Rotenone	1% dust
Silica gel (with pyrethrin and piperonyl butoxide)	40% dust

*Commercial use only.

Restrictions -

Avoid contamination of food, feedstuffs, and water supplies.

References -

1. Agric. Can., Pub. 1736/E.

CRICKETS

Crickets

Chemical Control -

	Rate
*Bendiocarb	0.125-0.25% in water or 1% dust
Carbaryl (outdoors)	5% dust
*Chlorpyrifos EC	0.25-0.5% spray
Chlorpyrifos (0.5% ready-to-use solution)	50 mL/m^2
Diazinon	0.5-1% spray or 2% dust
Malathion (outdoors)	4% dust
Methoxychlor	2-3% spray or 5% dust
Methoxychlor (with pyrethrin and piperonyl butoxide)	aerosol - follow label
Propoxur	1% spray
*Pyrethrins (encapsulated)	0.08-0.22% spray
*Ronnel (with synergized pyrethrins)	1-1.5% spray

*Commercial use only.

Restrictions -

Avoid contamination of food, feedstuffs, and water supplies.

References -

1. Agric. Can., Pub. 1736/E.

EARWIGS

Earwigs

Chemical Control -	Rate
Bendiocarb	0.25% in water or 1% dust
Carbaryl (outdoors)	1% spray or 5% dust
*Chlorpyrifos EC	0.25-0.5% spray
Chlorpyrifos (0.5% ready-to-use solution)	50 mL/m^2
*Diazinon (encapsulated)	0.5-1% spray
Diazinon	0.5-1% spray
*Malathion(premium grade)	3% spray
Methoxychlor	5% dust
Propoxur	1% spray
Resmethrin	0.25% spray

*Commercial use only.

Restrictions -

Carbaryl, methoxychlor: Do not use indoors.
Avoid contamination of food, feedstuffs, and water supplies.

References -

1. Agric. Can., Pub. 1752 E.

FLEAS

Fleas

Chemical Control -	Rate
*Bendiocarb	0.25% in water or 1% dust
*Chlorpyrifos EC	0.25-0.5% spray
Chlorpyrifos (0.5% ready-to-use solution)	50 mL/m^2
*Diazinon (encapsulated)	0.5% spray
Diazinon	0.5% spray or 2% dust
*Malathion (premium grade)	3% spray
Methoxychlor	1% spray
Propoxur	1% spray
*Pyrethrins (encapsulated)	0.08-0.22% spray
Resmethrin	0.25% spray

*Commercial use only.

Restrictions -

Avoid contamination of food, feedstuffs, and water supplies. Do not apply to pets or animals. Several flea powders are available for animals.

References -

1. Agric. Can., Pub. 1736 E.

HOUSE FLIES

House flies

Chemical Control -	**Rate**
Dichlorvos (slow-release strip or block)	follow label
*Malathion (premium grade)	3% spray
*Pyrethrins (encapsulated)	0.08-0.22% spray
Pyrethrins	aerosol or space spray
Resmethrin	0.25% pressurized spray

Restrictions -

Avoid contamination of food, feedstuffs, and water supplies.

References -

1. Agric. Can., Pub. 1736/E.

SILVERFISH

Silverfish

Chemical Control -	**Rate**
*Bendiocarb	0.125-2.5% in water or % dust
*Chlorpyrifos EC	0.25-0.5% spray
Chlorpyrifos (0.5% ready-to-use solution)	50 mL/m^2
*Diazinon (encapsulated)	0.5-1% spray
Diazinon	1% spray or 2% dust
*Malathion (premium grade)	2% spray
Methoxychlor	0.5-1% spray
Methoxychlor (with pyrethrin and piperonyl butoxide)	aerosol - follow label
Propoxur	1% spray
*Pyrethrins (encapsulated)	0.08-0.22% spray

*Commercial use only.

Restrictions -

Avoid contamination of food, feedstuffs, and water supplies.

References -

1. Agric. Can., Pub. 1736/E.

SOWBUGS

Sowbugs

Chemical Control -	**Rate**
*Bendiocarb	0.25% in water or 1% dust
*Chlorpyrifos EC	0.25-0.5% spray
Chlorpyrifos (0.5% ready-to-use solution)	50 mL/m^2
Diazinon	0.5% spray
*Malathion (premium grade)	2% spray
Propoxur	1% spray
Resmethrin	0.25% spray

*Commercial use only.

Restrictions -

Avoid contamination of food, feedstuffs, and water supplies.

References -

1. Agric. Can., Pub. 1736/E.

SPIDERS

Spiders

Chemical Control -	**Rate**
*Bendiocarb	0.25% in water or 1% dust
Chlorpyrifos	0.25% spray
Propoxur	0.5-0.84% aerosol or 1% spray
Pyrethrins	aerosols - follow label

*Commercial use only.

STORED FOOD INSECTS

Confused flour beetle, Granary weevil, Indian meal moth, Larder beetle, Mediterranean flour moth, Merchant grain beetle, Spider beetle, Yellow mealworm

Cultural Control -

Removal of food residues and thorough cleaning of infested areas is necessary to prevent reinfestations.

Chemical Control -	**Rate**
*Malathion (premium grade)	2% spray
Propoxur	1% spray
Pyrethrins	0.15% spray
*Pyrethrins (encapsulated)	0.08-0.22% spray

*Commercial use only.

Restrictions -

Do not use as space spray. Do not contaminate food, utensils, or surfaces that will contact foods.

References -

1. Agric. Can., Pub. 1736/E.

STRAWBERRY ROOT WEEVIL

Strawberry root weevil

Chemical Control -	**Rate**
Malathion 50% EC (outdoors)	1.6 mL/L
Methoxychlor EC	5% spray

Apply spray to lawn and ground around building foundation.

References -

1. MacNay, Agric. Can., Pub. 1333, 1967.

WASPS

Wasps

Chemical Control -	Rate
*Bendiocarb	0.25% in water or 1% dust
Malathion (outdoors)	2% spray
Methoxychlor (with permethrin and piperonyl butoxide)	aerosol - follow label
Propoxur	0.5% pressurized pencil spray
Resmethrin	0.25% spray

*Commercial use only.

Restrictions -

Avoid contamination of food, feedstuffs, and water supplies.

References -

1. Agric. Can., Pub. 1736/E

HOME VEGETABLE CROPS

L. Harris

The pesticides listed below for the home vegetable garden usually are available in small package sizes. Adhere to the wait periods to harvest and other restrictions given on the container label.

NOTE: Recommendations are in terms of formulated product, not active ingredient.

APHIDS

Aphids

Cultural Control -

Do not spray if large numbers of ladybugs or lacewings are present on the plants.

Chemical Control -

Active Ingredient	Rate
Diazinon 12.5% EC	7.8 mL/L
Dimethoate 240 EC	0.4-1.6 mL/L
Endosulfan	2-5% dust
Malathion 50% EC	1.6 mL/L
Rotenone or pyrethrins, near harvest.	

Restrictions -

Malathion: Do not apply at air temperatures below 20°C.

COLORADO POTATO BEETLE

Colorado potato beetle

Chemical Control -

Active Ingredient	Rate
Carbaryl 15% (liquid suspension)	5.0 mL/L
Diazinon 12.5% EC	7.8 mL/L
Endosulfan	2-5% dust
Malathion 50% EC	1.6 mL/L
Methoxychlor 25% EC	9.7 mL/L
Rotenone	1% dust

Restrictions -

Malathion: Do not apply at air temperatures below 20°C.

CUTWORMS

Cutworms (subterranean spp.)

Cultural Control -

Removal of vegetable trash and weeds in August will reduce the incidence of cutworms the next year.

Chemical Control -

Active Ingredient	Rate
Chlorpyrifos 0.5% G	40 g/m^2
Chlorpyrifos 10% EC	1.25 mL/m^2
Diazinon 5 G	10 g/m^2

Broadcast and incorporate into the soil before planting or shake around plants.

Restrictions -

Chlorpyrifos: Use only once per season 70 days before harvest and not on bunching onions.

FLEA BEETLES

Flea beetles

Chemical Control -

Active Ingredient	Rate
Carbaryl 15% (liquid suspension)	5.0 mL/L
Diazinon 12.5% EC	7.8 mL/L
Endosulfan	2-5% dust
Malathion 50% EC	7.8 mL/L
Methoxychlor 25% EC	9.7 mL/L
Rotenone	1% dust

Restrictions -

Malathion: Do not apply at air temperatures below 20°C.

GRASSHOPPERS

Grasshoppers

Chemical Control -

Active Ingredient	Rate
Dimethoate 240 EC	1-2 mL/L
Malathion 50% EC	1.6 mL/L

Restrictions -

Malathion: Do not apply at air temperatures below 20°C.

LOOPERS

Loopers: Cabbageworms, Diamondback moth, and other caterpillars

Biological Control -

Bacillus thuringiensis (var. *kurstaki*) follow label instructions.

Chemical Control -

Active Ingredient	Rate
Diazinon 12.5% EC	7.8 mL/L
Endosulfan	2-5% dust
Malathion 50% EC	3.9 mL/L
Methoxychlor 25% EC	9.7 mL/L
Rotenone	1% dust

Restrictions -

Malathion: Do not apply at air temperatures below 20°C.

ONION MAGGOT

Onion maggot

Cultural Control -

Remove and destroy all crop debris immediately after harvest. Delay transplanting Spanish onions until 10 June.

Chemical Control -

Active Ingredient	Rate
Diazinon 5 G (in furrow at planting)	10 g/10 m row
*Diazinon 12.5% EC (drench)	7.8 mL/L
Ethion 2.5% G (in furrow at planting)	4.0 g/m row

Apply drench treatments to emerging seedlings or transplant the last week in May.

Restrictions -

Commercial use only.

ROOT MAGGOTS

Root maggots (cruciferous)

Cultural Control -

Remove and destroy all crop debris immediately after harvest.

Chemical Control -

Active Ingredient	Rate
Diazinon 5 G (in furrow but not in contact with seed)	30 g/10 m row
Diazinon 5 G (transplants)	3 g/plant
Diazinon 12.5% EC (drench)	7.8 mL/L

For cabbage and radish maggot, apply drench treatments after emergence and again from late July to mid-August.
For turnip maggot, apply drench in early and late July.

SLUGS

Slugs

Cultural Control -

Remove all vegetable trash and other debris from in and around gardens. Place boards between rows and collect and destroy the slugs that gather under them each morning.

Chemical Control -

Active Ingredient	Rate
Carbaryl bait:	place around plants.
Metaldehyde:	liquid bait or pellets. **Do not contaminate edible portion of the plants.**
Methiocarb :	scatter 500 g/m^2 over foliage or soil.

TUBER FLEA BEETLE

Tuber flea beetle

Chemical Control -

Active Ingredient	Rate
Sevin 15% (liquid suspension)	5 mL/L
Methoxychlor 25 EC	6 mL/L

Apply when adult beetles first appear or when feeding damage is visible on the leaves.

WHITE GRUBS

White grubs

Cultural Control -

Avoid planting in recently cultivated soil: leave soil dormant for one growing season to avoid problems.

Chemical Control -

Active Ingredient	Rate
Diazinon 5 G	10 g/m^2

Broadcast and incorporate into the top 7-15 cm of soil before seeding.

WIREWORMS

Wireworms in potatoes

Cultural Control -

Avoid planting potatoes in soil which has been in sod or sown to grasses for at least 3 years after cultivating.

COMMERCIAL VEGETABLE CROPS

R.S. Vernon and J. McCullough

APHIDS

Aphids

Economic threshold -

Take 25, 180° sweeps at four locations in the field at first bloom. Treat if average number of aphids/sweep exceeds 15 - 20.

Chemical Control -

Active Ingredient	Rate (g AI/ha)	Preharvest Interval	Crop	References
Carbofuran	540	7	Potato	2,7
Dimethoate	140-200	3	Pea, field	
	280-325	3	Pea, chard, kale, lettuce, spinach	
	280-325	12	Beet	
	280-560	4	Broccoli, cabbage, cauliflower	8
	280-560	7	Bean	
	280-560	21	Brussel sprouts	8
	280-675	7	Potato, tomato	5
	500-1000	21	Asparagus	12
Disulfoton	1100	180	Asparagus	12
	1100	28	Lettuce	13,14
Endosulfan	560-1200	2	Tomato	
	560-1200	5	Broccoli, brussel sprouts, cabbage,cauliflower	
	560-1400	2	Bean	
	840-1200	5	Lettuce, spinach	
	840-1400	5	Pea, potato	2
	1125	50	Corn	
Fenvalerate	70-100	7	Potato	9
Malathion	560-1400	3	Broccoli, egg plant, pepper	
	560-1400	7	Brussel sprouts, beet, cabbage, carrot, cauliflower, radish, turnip	
	700-1000	3	Tomato, potato	
	700-1400	1	Bean	
	700-1400	3-14	Field lettuce	
	700-1400	7-21	Greenhouse lettuce	
	1000	3	Pea, cucumber, celery, field pea	6
	1000-1400	5	Corn	
	1400-1750	7	Spinach	
Methamidophos	560-1125	7	Cabbage, cauliflower	3
	560-1125	14	Broccoli, brussel sprouts, head lettuce	3
	840-1000	14	Potato	2,4
Oxydemeton-methyl	560	180	Asparagus	12

Pirimicarb	70-140	6	Peas	1
	210-280	7	Potato	4
	280	3	Corn (sweet)	-
	150-250	7	Lettuce	10
	250	7	Asparagus	12

Restrictions -

Fenvalerate: Do not apply to crops grown in low lying or wet soils.
Malathion: Do not apply at air temperatures below 20°C

References -

1. Baillargeon, Pest. Res. Rep. 1978:193.
2. Campbell and Finlayson, Can. J. Plant Sci. 56:869,1976.
3. Finlayson, Can. J. Plant Sci. 59:399,1978.
4. Finlayson and Mackenzie, Pest, Res. Rep. 1978:243.
5. Huston, Pest. Res. Rep. 1974:217.
6. McLanahan and Founk, Pest. Res. Rep. 1975:105.
7. McLanahan and Founk, Pest. Res. Rep. 1975:124.
8. MacCarthy, Proc. Entomol. Soc. B.C. 59:5, 1962.
9. Ritcey et al., Pest. Res. Rep. 1978:234.
10. Mackenzie and Vernon, Pest. Res. Rep. 1982:115.
11. Lamb and Maiteki, Canadex: Pea aphid control on field peas.
12. Vernon and Houtman, J. Entomol. Soc. B.C. 1983:80.
13. Vernon and Mackenzie, Pest. Res. Rep. 1985:97
14. Vernon and Mackenzie, Pest. Res. Rep. 1986:82

ASTER LEAFHOPPER

Aster leafhopper (lettuce)
Chemical Control -

Active Ingredient	Rate (g AI/ha)	Preharvest Interval	References
Malathion	1125	7-14	1
Phorate	1125	-	1

Restrictions -

Malathion: Spray twice weekly starting at insect emergence. Do not treat within 14 days of harvest of leaf lettuce, 7 days on head lettuce. Do not apply at air temperatures below 20°C.
Phorate: Use at seeding or transplanting only. Do not place phorate in contact with seed.

References -

1. Richardson and Westdal, Can. J. Plant Sci. 44:393, 1964.

COLORADO POTATO BEETLE

Colorado potato beetle
Chemical Control -

Active Ingredient	Rate (g AI/ha)	Preharvest Interval	References
*Azinphos-methyl	280-420	7	3
Carbaryl	560	7	5
+Carbofuran	210	7	3,5
Deltamethrin	5-7.5	23	1,2,6,8
*Endosulfan	560	1	5
Fenvalerate	30-45	7	4
Methamidophos	840-910	14	5
Methidathion	280	14	3,5
Permethrin	78-105	1	-

+Apply in 220 L water/ha.
*Azinphos-methyl and endosulfan rates may be halved if row crop equipment is used and adequate coverage achieved.

Restrictions -

Fenvalerate: Do not apply to crops grown in low-lying or wet soils.
Deltamethrin: Only 2 applications by air.

References -

1. Catellier and McVicar, Pest. Res. Rep. 1982.
2. Dobson and McLean, Pest. Res. Rep. 1980:93.
3. McDonald, Pest. Res. Rep. 1973:254.
4. Pitblado, Pest. Res. Rep. 1978:222.
5. Rioux, Pest. Res. Rep. 1972:109.
6. Westdal et al., Pest. Res. Rep. 1980:100.
7. Westdal et al., Pest. Res. Rep. 1981:96.
8. Wise and McVicar, Pest. Res. Rep. 1981:97.

CUTWORMS

Cutworms - redbacked
Chemical Control -

Active Ingredient	Rate (g AI/ha)	Preharvest Interval	Crop
Chlorpyrifos	560-1125	7	potato
(liquid formulation)		30	rutabaga
		32	cabbage, broccoli, brussel sprouts,

Chlorpyrifos (liquid formulation)	560-1125	32	chinese cabbage, cauliflower
		40	pepper
		60	cucumber, carrot, bulb onion
		70	celery, tomato, corn (field & sweet), tomato

EUROPEAN CORN BORER

European corn borer
Chemical Control -

Active Ingredient	Rate (g AI/ha)	Preharvest Interval	References
Carbaryl	2250	1	1
Methomyl	560	3	2
Permethrin	100-140	1	2

Restrictions -

Treated crop should not be used as green feed for animals.

References -

1. Pitblado, Pest. Res. Rep. 1978:180.
2. Pitblado, Pest. Res. Rep. 1978:181.

FLEA BEETLES

Flea beetles
Chemical Control -

Active Ingredient	Rate (g AI/ha)	Preharvest Interval	Crop	References
Carbofuran	525	7	potato	1, 3
Diazinon	560	10	radish, parsnip, salsify, potato, turnip (rutabaga)	-
Endosulfan	560-1000	2	cucumber, melon, pumpkin, squash	-
	560-1200	2	egg plant, pepper, tomato	
		7	broccoli, brussel sprouts, cabbage, cauliflower	-
	560-1400	1	potato	2
	850-1200	45	turnip	-
Fenvalerate	30-45	7	potato	3
Malathion	560-1400	7	radish	-
Methamidophos	840-1125	14	potato	-
Methidathion	275	14	potato	1,3
Permethrin	75-105	1	potato	-

Restrictions -

Fenvalerate: Do not apply to crops grown in low-lying or wet soils.
Malathion: Do not apply when air temperature is below 20°C.

References -

1. McEwan et al., Pest. Res. Rep. 1975:129.
2. Rioux, Pest. Res. Rep. 1973:129.
3. Ritcey et al., Pest. Res. Rep. 1978:234.

GRASSHOPPERS

Grasshoppers
Chemical Control -

Active Ingredient	Rate (g AI/ha)	Preharvest Interval	Crop	References
Carbofuran	140	7	corn	-
Malathion	840	-	-	-

Restrictions -

Check label for interval required between application and harvest.
Malathion: Do not apply at air temperatures below 20°C.

IMPORTED CABBAGEWORM, DIAMONDBACK MOTH & LOOPERS

Imported cabbageworm, Diamondback moth & Loopers
Biological Control -

Active Ingredient	Rate (g AI/ha)	Preharvest Interval	Crop	References
Bacillus thuringiensis (Berliner) 7.26 x 10^9 I.U./lb	560-1125	0	Broccoli, brussel sprouts, cabbage, cauliflower	1,4,5

Chemical Control -

Deltamethrin	7.5-10	3	broccoli, brussel sprouts, cauliflower, cabbage	1,3,6,9-13
Diazinon	560	7	broccoli, brussel sprouts, cabbage cauliflower	5
Endosulfan	840-1125	7	broccoli,brussel sprouts, cabbage, cauliflower	4,8
Fenvalerate	50-100	14	brussel sprouts, cabbage, cauliflower	3
Methamidophos	560-1125	7	cabbage, cauliflower	2,7,8
		14	broccoli, brussel sprouts	-

Methomyl	280-560	7	broccoli, brussel sprouts, cabbage, cauliflower	2,7,8
Permethrin	35-70	3	brussel sprouts, cabbage, cauliflower	2
		7	broccoli	-
Rotenone (1% dust)	22.5 kg/ha	-	-	-

Restrictions -

Permethrin: Treated crop should not be used as green feed for animals.

References -

1. Brown et al., Pest. Res. Rep. 1980:70.
2. Finlayson, Can. J. Plant Sci. 59:399,1979.
3. Finlayson, Pest, Res. Rep. 1980:68.
4. Harcourt and Cass, Pest. Res. Rep. 1963:90.
5. MacCarthy, Proc. Entomol. Soc. B.C. 59:5,1962.
6. McEwan and Ritcey, Pest. Res. Rep. 1973:84.
7. Rioux, Pest. Res. Rep. 1973:80.
8. Sears and McGraw, Pest. Res. Rep. 1980:69.
9. Sears and McGraw, Pest. Res. Rep. 1980:77.
10. Sears and McGraw, Pest. Res. Rep. 1981:72.
11. Wise and Blouw, Pest. Res. Rep. 1981:68.
12. Mackenzie and Vernon, Pest. Res. Rep. 1981:63.
13. Mackenzie and Vernon, Pest. Res. Rep. 1982:67.

ONION MAGGOT

Onion maggot

Chemical Control -

Furrow treatments (kg AI/ha)

Active Ingredient	Onions For Sets	Table Onions	Greenhouse Onions	References
Diazinon	2.75-3.35	1.68	1.68	1,2,4
Ethion	2.75-3.35	1.68	1.68	2-4
Fensulfothion	0	1.13	0	3
Fonofos	1.1	1.1	1.1	-

Insecticide granules should be applied to rows spaced at 40 cm, with a positive feed Gandy-type applicator calibrated for correct delivery. Apply granules in the furrow with the seed.

Restrictions -

Fonofos: Organic soils only 10% O.M.

Fensulfothion: Do not use on green bunching onions.

Drench treatments (kg AI/ha)

Active Ingredient	Onions For Sets	Table Onions	Greenhouse Onions	References
*Diazinon	0	1.13-2.25	1.13-2.25	-

*For soil drench, use 1100 L water/ha (7-9.5 g diazinon/10 L water/100 m of row).

Life cycles differ in various areas, spray programs must be scheduled to obtain maximum efficacy.

References -

1. Allen and Ashraff, Pest. Res. Rep. 1967:103.
2. Finlayson, Proc. Entomol. Soc. B.C. 62:3,1965.
3. McEwen et al., Pest. Res. Rep. 1970:103.
4. Perron, Can. J. Plant Sci. 42:616,1962.

POTATO LEAFHOPPER & PLANT BUGS

Potato leafhopper & Plant bugs (potato)
Chemical Control -

Active Ingredient	Rate (g AI/ha)	Preharvest Interval	Crop	References
Fenvalerate	30-95	7	-	2
Methidathion	275	14	-	1,2
Permethrin	75-105	1	-	-

References -

1. McEwen et al., Pest. Res. Rep. 1975:129.
2. Ritcey et al., Pest. Res. Rep. 1978:234.

ROOT MAGGOTS

Root maggots (rutabagas and other crucifers)
Chemical Control - **Band Treatment (direct seeded crop)**

Active Ingredient	Rate (g AI/1000 m row)	Crop	References
Carbofuran	175	Rutabaga	3-5,7
Chlorfenvinphos	175	Broccoli, brussel sprouts, cabbage, cauliflower,	
Chlorfenvinphos	175	rutabaga	1,3-5,7

Chlorpyrifos	90-150	Brussel sprouts, rutabaga	8
Diazinon (in-furrow)	90	Radish in muck soil	2,6
Fensulfothion	175	Broccoli, brussel sprouts, cabbage, cauliflower, rutabaga	1,3-5,7

Work granules into top 2 cm of soil in a 15-cm band, seed down centre, or apply with a Gandy applicator by placing the delivery fan in front of the seed coulter. The granules are applied and incorporated by the bow-wave action of the seeder.

Drench treatment

Active Ingredient	Rate (g AI/ha)	Preharvest Interval	Crop	References
Carbofuran	2.25	40	Rutabaga	3-5,7
Chlorfenvinphos	2.25	40	Brussel sprouts, broccoli, cabbage, cauliflower, rutabaga	3-5,7
Chlorpyrifos	1.7	32	Broccoli, cabbage, cauliflower, brussel sprouts, rutabaga	8
Diazinon	1.40	10	Radish in mineral soil	2,6
Fensulfothion	2.25	40	Brussel sprouts, broccoli, cabbage, cauliflower rutabaga	3-5,7

Notes: Apply drench when seedlings first emerge. Additional treatments: apply at 1100-1700 L of solution/ha. Life cycles – These differ in various areas and spray programs must be scheduled to obtain maximum efficacy.

CAUTION -

Chlorfenvinphos: Severe burning of foliage may result, especially when solution is poorly agitated or low volume of water is used.

Restrictions -

Carbofuran: Drench-applied; one at 45 days or two at 30 and 60 days after seeding.

Chlorfenvinphos: One drench 45 days after seeding.

Chlorpyrifos: Rate based on 60 cm row spacing. Apply 1 drench application 7-10 days after seeding or 3 days after transplanting.

Diazinon: Drench-applied. In mineral soil, one when half the radish seedlings have emerged, a second 15 days later. In muck soil, one at 15-20 days after seeding.

Fensulfothion: Drench-applied; one at 45 days or two at 30 and 60 days after seeding.

References -

1. Finlayson, Can. J. Plant Sci. 59:399,1979.
2. Finlayson and Noble, Proc. Entomol. Soc. B.C. 61:ll, 1964.
3. Finlayson and Noble, Plant Sci. 46:459:1966.
4. Finlayson et al., J. Econ. Entomol. 60:132,1967.
5. McDonald and Swailes, Pest. Res. Rep. 1971:146.
6. Beausoleil and Ritchot, Pest. Res. Rep. 1975:156.
7. Swailes and McDonald, Pest. Res. Rep. 1969:156.
8. Mackenzie and Vernon, J. Entomol. Soc. B.C. 84:9:1987

WIREWORMS

Wireworms
Chemical Control -

106 1.12 - 14 kg/ha (4.5 - 5.6 kg/ac) in 20 cm band
44.5 kg/ha (17.8 kg/ac) broadcast + incorp. 5 cm.

Active Ingredient	Rate (kg AI/ha)	Crop	References
Fonofos	2.3 (in-furrow)	potato	1,2,4
	5.6 (broadcast)	potato	2,4
Terbufos	75 g/100 m	corn (7.5 kg/ha, 3 kg/ac)	3,5,6

Broadcast application, apply immediately before seeding, and harrow, disc or roto-till into top 12 cm of soil.

Restrictions -

Fonofos: Use 10% granular for in-furrow treatment at time of seeding. Use only on irrigated soils.

Terbufos: Apply in-furrow to crops with minimum 75 cm row spacing.

References -

1. Burrage, Pest. Res. Rep. 1969:127.
2. Lilly, J. Econ. Entomol. 66:1205,1973.
3. Wilkinson et al., J. Entomol. Soc. B.C. 73:3,1976.
4. Wilkinson et al., J. Entomol. Soc. B.C. 75:3,1978.
5. Wilkinson, Pest. Res. Rep. 1974:188.
6. Wilkinson, Pest. Res. Rep. 1975:111.

GREENHOUSE CROPS

M. Steiner and J. McCullough

The following use patterns are in accordance with labels on commercial and restricted class products registered for use in commercial greenhouses. For additional use patterns refer to section on domestic class products for interior plantscapes and houseplants.

It is important to alternate between chemical families to delay resistance build-up in problem pests.

All chemicals may be phytotoxic to some plants or plant stages or under certain conditions. Consult label for additional information or refer to Alberta Agriculture Garden Fax Leaflet 270/621-1 "Susceptibility of Some Ornamental Plants to Pesticide Injury".

ORNAMENTAL CROPS

APHIDS

Aphids
Chemical Control -

Active Ingredient	Rate (AI)	Crop(s)
Aldicarb	60-125 g/100 m^2	Chrysanthemum
Diazinon	50-75 g/100 L	Chrysanthemum Carnation, Rose
Dichlorvos	1 can/300 m^3 as a smoke 3.5 g/100 m^3 as a fog	Ornamentals
Endosulfan	50 g/100 L	Ornamentals
Kinoprene	32.5 - 97.5 g/100L	Ornamentals
Lindane	25 g/100 L or 1 pellet for 255 m^3 as a smoke 0.7 g/100 m^3 as a fog	Ornamentals
Malathion	65-125 g/100 L	Ornamentals
Naled	8.6 g/100 m^3 vaporized from heating pipes	Ornamentals
Nicotine sulfate	1 can/300 m^3 vaporized as a smoke	Ornamentals

Oxydemeton-methyl	45-90 g/100 L	Ornamentals
Parathion	1 can/300 m^3 as a smoke	Ornamentals
Pirimicarb	25 g/100 L	Ornamentals
Soap	1 kg/100 L	Ornamentals
Sulfotep	1 can/300 m^3 as a smoke 1.7 g/100 m^3 as a fog	Ornamentals

Restrictions -

Aldicarb: Do not work treated area within 48 hours of applying. Do not market potted plants within 4 weeks of last application. Do not plant food crops in soil previously treated with aldicarb for at least 1 year. This product is no longer sold for greenhouse use.

Smokes, fogs, and other fumigants: Special protective equipment required and thorough ventilation of house after exposure period. Water plants well, but ensure that blossoms and foliage are dry before applying treatment.

BLACK VINE WEEVIL

Black vine weevil

Chemical Control -

Active Ingredient	Rate (AI)	Crop(s)
Endosulfan	50 g/100 L	Ornamentals
Heterorhabditis heliothidis (nematode)	5,000 nematodes/L soil	Woody Ornamentals
Methoxychlor	30 g/100 L	Ornamentals

CATERPILLARS

Caterpillars

Chemical Control -

Active Ingredient	Rate (AI)	Crop(s)
Acephate	64 g/100 L	Rose
Bacillus thuringiensis	Follow label	Chrysanthemum, Rose

Diazinon	50-75 g/100 L	Chrysanthemum, Carnation
Dichlorvos	1 can/300 m^3 as a smoke 3.5 g/100 m^3 as a fog	Ornamentals
Endosulfan	50 g/100 L	Ornamentals
Naled	8.6 g/100 m^3 vaporized from heating pipes	Ornamentals
Parathion	1 can/300 m^3 as a smoke	Ornamentals

Restrictions -

Smokes, fogs and other fumigants: Special protective equipment required and thorough ventilation of house after exposure period. Water plants well, but ensure that blossoms and foliage are dry before applying treatment.

CYCLAMEN MITE

Cyclamen mite

Chemical Control -

Active Ingredient	Rate (AI)	Crop(s)
Dicofol	23-47 g/100 L	Ornamentals
Endosulfan	50 g/100 L	Ornamentals

FUNGUS GNATS

Fungus gnats

Chemical Control -

Active Ingredient	Rate (AI)	Crop(s)
Bendiocarb	100 g/100 L	Ornamentals
Malathion	50 g/100 L	Ornamentals

GREENHOUSE WHITEFLY

Greenhouse whitefly
Chemical Control -

Active Ingredient	Rate (AI)	Crop(s)
Aldicarb	60-125 g/100 m^2	Chrysanthemum, Poinsettia
Chlorpyrifos	37 g/100 L	Ornamentals
Dichlorvos	1 can/300 m^3 as a smoke 3.5 g/100 m^3 as a fog	Ornamentals
Endosulfan	50 g/100 L	Ornamentals
Kinoprene	32.5-97.5 g/100 L	Ornamentals
Lindane	25 g/100 L or 1 pellet /255 m^3 as a smoke	Ornamentals
Malathion	65-125 g/100 L	Ornamentals
Naled	8.6 g/100 m^3 vaporized from heating pipes	Ornamentals
Parathion	1 can/300 m^3 as a smoke	Ornamentals
Permethrin	10 g/100 L	Aspidistra, Begonia, Boston fern, Chrysanthemum, Cordyline, Dieffenbachia, Dracaena, Ficus, Fuchsia, Geranium, Gerbera, Impatiens, Petunia, Philodendron, Poinsettia, Rose, Sansevieria, Spider plant
Resmethrin	0.29% ready to use concentrate	African violet, Azalea, Chrysanthemum, Cineraria, Dieffenbachia, Fuchsia, Gloxinia, Ivy, Jerusalem cherry, Lantana, Neanthebellapalm, Petunia, Rose, Snapdragon
Soap	1 kg/100 L	Ornamentals
Sulfotep	1 can/300 m^3 as a smoke 1.7 g/100 m^3 as a fog	Ornamentals

Restrictions -

Aldicarb: Do not work treated area within 48 hours of applying. Do not market potted plants within 4 weeks of last application. Do not plant food crops in soil previously treated with aldicarb for at least l year.

Smokes, fogs, and other fumigants: Special protective equipment required and thorough ventilation of house after exposure period. Water plants well, but ensure blossoms and foliage are dry before applying treatment.

LEAFMINERS

Leafminers

Chemical Control -

Active Ingredient	Rate (AI)	Crop(s)
Larvae:		
Acephate	64 g/100 L	Rose
Aldicarb	60-125 g/100 m^2	Chrysanthemum
Pyrazophos	45 g/100 L	Chrysanthemum
Adults:		
Diazinon	50 g/100 L	Azalea, Carnation, Chrysanthemum
Dichlorvos	3.5 g/100 m^3 as a fog	Chrysanthemum
Malathion	65-125 g/100 L	Ornamentals
Permethrin	10 g/100 L	Chrysanthemum

Restrictions -

Aldicarb: Do not work treated area within 48 hours of applying. Do not market potted plants within 4 weeks of last application. Do not plant food crops in soil previously treated with aldicarb for at least l year.

LYGUS BUGS

Lygus bugs
Chemical Control -

Active Ingredient	Rate (AI)	Crop(s)
Malathion	65-125 g/100 L	Ornamentals
Parathion	1 can/300 m^3 as a smoke	Ornamentals

Restrictions -

Parathion: Special protective equipment required and thorough ventilation of house after exposure period. Water plants well, but ensure that blossoms and foliage are dry before applying treatment.

MEALYBUGS

Mealybugs
Chemical Control -

Active Ingredient	Rate (AI)	Crop(s)
Chlorpyrifos	96 g/100 L	Ornamentals
Dichlorvos	1 can/300 m^3 as a smoke 3.5 g/100 m^3 as a fog	Ornamentals
Malathion	65-125 g/100 L	Ornamentals
Naled	8.6 g/100 m^3 vaporized from heating pipes	Ornamentals
Parathion	1 can/300 m^3 as a smoke	Ornamentals
Soap	1 kg/100 L	Ornamentals
Sulfotep	1 can/300 m^3 as a smoke 1.7 g/100 m^3 as a fog	Ornamentals

Restrictions -

Smokes, fogs, and other fumigants: Special protective equipment required and thorough ventilation of house after exposure period. Water plants well, but ensure that blossoms and foliage are dry before applying treatment.

SCALES

Scales

Chemical Control -

Active Ingredient	Rate (AI)	Crop(s)
Acephate	64 g/100 L	Rose
Bendiocarb	60 g/100 L	Ornamentals
Chlorpyrifos	91 g/100 L	Ornamentals
Soap	1 kg/100 L	Ornamentals
Sulfotep	1 can/300 m^3 as a smoke 1.7 g/100 m^3 as a fog	Ornamentals

Restrictions -

Sulfotep: Special protective equipment required and thorough ventilation of house after exposure period. Water plants well, but ensure that blossoms and foliage are dry before applying treatment.

Bendiocarb: Preharvest interval 14 days; re-entry period 24 hours.

SLUGS and SNAILS

Slugs and Snails

Chemical Control -

Active Ingredient	Rate (AI)	Crop(s)
Methiocarb	10 g/100 m^2 as a scatter bait	Ornamentals

THRIPS

Thrips

Chemical Control -

Active Ingredient	Rate (AI)	Crop(s)	References
Bendiocarb	60-80 g/100 L	Ornamentals	
Chlorpyrifos	24 g/100 L	Ornamentals	
Deltamethrin	1.75-2.5 g/100 L	Chrysanthemum, Cineraria, Easter Lily, Geranium	1
Diazinon	50-75 g/100 L as a foliar spray or a soil surface spray	Chrysanthemum, Carnation, Rose	
Dichlorvos	1 can/300 m^3 as a smoke or 3.5 g/100 m^3 as a fog	Ornamentals Ornamentals	
Lindane	1 pellet/255 m^3 as a smoke or 25 g/100 L	Ornamentals	
Malathion	65-125 g/100 L	Ornamentals	
Nicotine	1 can/300 m^3 as a smoke	Ornamentals	
Parathion	1 can/300 m^3 as a smoke	Ornamentals	

Restrictions -

Smokes, fogs and other fumigants: Special protective equipment required and thorough ventilation of house after exposure period. Water plants well, but ensure that blossoms and foliage are dry before applying treatment.

Deltamethrin: Do not apply within 7 days of crop harvest. Do not use with fogging machines.

Bendiocarb: Preharvest interval 14 days, re-entry period 24 hours.

References -

1. Steiner, Pest Res. Rep. 1985:206.

TWO-SPOTTED SPIDER MITE

Two-spotted spider mite
Chemical Control -

Active Ingredient	Rate (AI)	Crop(s)
Aldicarb	60-125 g/100 m^2	Chrysanthemum, Poinsettia
Dichlorvos	1 can/300 m^3 as a smoke 3.5 g/100 m^3 as a fog	Ornamentals
Dicofol	23-47 g/100 L	Ornamentals
Dienochlor	30 g/100 L	Azalea, Begonia, Carnation, Chrysanthemum, Delphinium, Gardenia, Poinsettia, Rose, Snapdragon, Zinnia
Fenbutatin-oxide	25-50 g/100 L	Ornamentals
Malathion	7-14 g/100 m^2	Ornamentals
Naled	8.6 g/100 m^3 vaporized from heating pipes	Ornamentals
Oxydemeton-methyl	45-90 g/100 L	Ornamentals
Parathion	1 can/300 m^3 as a smoke	Ornamentals
Soap	1 kg/100 L	Ornamentals
Sulfotep	1 can/300 m^3 as a smoke 1.7 g/100 m^3 as a fog	Ornamentals
Tetradifon	1 can/300 m^3 as a smoke	Ornamentals

Restrictions -

Aldicarb: Do not work treated area within 48 hours of applying. Do not market potted plants within 4 weeks of last application. Do not plant food crops in soil previously treated with aldicarb for at least 1 year.

Smokes, fogs, and other fumigants: Special protective equipment required and thorough ventilation of house after exposure period. Water plants well, but ensure that blossoms and foliage are dry before applying treatment.

GREENHOUSE VEGETABLE CROPS

Note: Wait period before harvest (PHI) in days.

APHIDS

Aphids
Chemical Control -

Active Ingredient	Rate (AI)	Crop(s)	PHI
Diazinon	50-75 g/100 L	Tomato	8
Dichlorvos	3.5 g/100 m^3 as a fog	Cucumber	7
		Tomato	7
Endosulfan	50 g/100 L	Tomato	2
		Cucumber	2
Malathion	7-14 g/100 m^2 or	Lettuce, heads	7
	65-125 g/100 L	Lettuce, leaf	21
Naled	8.6 g/100 m^3 vaporized from heating pipes	Cucumber	1
		Tomato	1
Nicotine	1 can/300 m^3 as a smoke	Cucumber	3
		Lettuce	7
		Tomato	3
Parathion	1 can/300 m^3 as a smoke	Cucumber	1
		Tomato	1
Soap	1 kg/100 L	Vegetables	0
		Peppers	5

Restrictions -

Smokes, fogs and other fumigants: Special protective equipment required and thorough ventilation of house after exposure period. Water plants well, but ensure that blossoms and foliage are dry before applying treatment.

Naled: Some phytotoxicity reported to flowers of cucumber and tomato.

CATERPILLARS

Caterpillars
Chemical Control -

Active Ingredient	Rate (AI)	Crop(s)	PHI
Bacillus thuringiensis	Follow label	Tomato	0
		Peppers	0
Naled	8.6 g/100 m^3 vaporized from heating pipes	Cucumber	1
		Tomato	1
Parathion	1 can/300 m^3 as a smoke	Cucumber	1
		Tomato	1

Restrictions -
Smokes, fogs, and other fumigants: Special protective equipment required and thorough ventilation of house after exposure period. Water plants well, but ensure that blossoms and foliage are dry before applying treatment.

GREENHOUSE WHITEFLY

Greenhouse whitefly
Integrated Control - with biological agents, see page 81.

Chemical Control -

Active Ingredient	Rate (AI)	Crop(s)	PHI
Dichlorvos	3.5 g/100 m^3 as a fog	Cucumber	7
		Tomato	7
Endosulfan	50 g/100 L	Cucumber	2
		Tomato	2
Naled	8.6 g/100 m^3 vaporized from heating pipes	Cucumber	1
		Tomato	1
Parathion	1 can/300 m^3 as a smoke	Cucumber	1
		Tomato	1
Permethrin	10 g/100 L	Cucumber	1
		Tomato	1
Plant Products Dormant Oil	1 L/100 L	Cucumber	3
Soap	1 kg/100 L	Vegetables	0

****Caution**** -

Plant Products Dormant Oil - May be phytotoxic at higher than recommended concentrations, or to younger leaves at temperatures of 25°C or higher. Do not use within 30 days of application of sulphur containing materials.

Restrictions -

Smokes, fogs, and other fumigants: Special protective equipment required and thorough ventilation of house after exposure period. Water plants well, but ensure that blossoms and foliage are dry before applying treatment.

References -

1. Steiner, Pest. Res. Rep. 1985, p. 196,197.

LEAFMINERS

Leafminers

Chemical Control -

Active Ingredient	Rate (AI)	Crop(s)	PHI
Diazinon	5.5-10 g/100 m^2	Tomato	8
Malathion	7-14 g/100 m^2	Tomato	3

THRIPS

Thrips

Chemical Control -

Active Ingredient	Rate (AI)	Crop(s)	PHI	References
*Diazinon	11 g/100 m^2 as a soil surface treatment	Cucumber	1	
Dichlorvos	3.5 g/100 m^3 as a fog	Cucumber Tomato	7 7	
Methomyl	4.75 g/100 L	Cucumber	3	1
*Nicotine sulfate	1 can/300 m^3 as a smoke	Cucumber Tomato Lettuce	3 3 7	
*Parathion	1 can/300 m^3 as a smoke	Cucumber Tomato	1 1	

Restrictions -

Smokes, fogs, and other fumigants: Special protective equipment required and thorough ventilation of house after exposure period. Water plants well, but ensure that blossoms and foliage are dry before applying treatment.

Note: Not very effective against western flower thrips.

References -

1. Steiner, Personal Communication.

TWO-SPOTTED SPIDER MITE

Two-spotted spider mite
Integrated Control- with biological agents, see page 81.

Chemical Control -

Active Ingredient	Rate (AI)	Crop(s)	PHI
Fenbutatin-oxide	25-50 g/100 L	Cucumber	3
		Tomato	5
Malathion	7-14 g/100 m^2	Lettuce leaf	21
		Lettuce head	7
		Tomato	3
Naled	8.6 g/100 m^3 vaporized from heating pipes	Cucumber	1
		Tomato	1
Parathion	1 can/300 m^3 as a smoke	Cucumber	1
		Tomato	1
Soap	1 kg/100 L	Vegetables	0
Tetradifon	1 can/300 m^3 as a smoke	Cucumber	1

Restrictions -

Smokes, fogs, and other fumigants: Special protective equipment required and thorough ventilation of house after exposure period. Water plants well, but ensure that blossoms and foliage are dry before applying treatment.

References -

1. Pesticide Recommendations for Greenhouse Ornamentals. Ont. Min. Agric. Food, Pub. 381, 1985.
2. B.C. Dept. Agric. Nursery, Greenhouse Vegetable and Ornamental Guide 1988/89.
3. Compendium of Pest Control Products Registered in Canada 1990 (microfiche).

INTEGRATED CONTROL OF TWO-SPOTTED SPIDER MITE AND GREENHOUSE WHITEFLY ON GREENHOUSE TOMATOES AND CUCUMBERS

Whiteflies and two-spotted spider mites on greenhouse tomatoes and cucumbers can be controlled by parasites and predators in conjunction with chemical insecticides. Chemicals and application methods for these and other pests should be selected to present minimal hazard to the biological agents. Heavily pest-infested areas may require spot treatment but overall sprays should be avoided. The biological agents should be introduced at the first sign of mites or whiteflies or as soon as the crop goes in if previous crops were infested. Introductions onto other than very low initial pest infestations have no chance for successful control.

Whitefly Control

At first signs of whitefly on yellow sticky strips, introduce the parasitic wasp *Encarsia formosa* at a rate of 1 per 4 plants for tomatoes and 1 per 2 plants for cucumbers. Repeat weekly for 9 weeks or until 80% of all whitefly scales turn black.

Spider Mite Control

Introduce the predatory mite *Phytoseiulus persimilis* at the rate of 1 per plant. Repeat at weekly intervals until established in the crop.

EFFECTS OF GREENHOUSE PESTICIDES ON BIOLOGICAL CONTROL AGENTS

Pesticide	Application	Effect on *E. formosa*	Effect on *P. persimilis*	Effect on *A. cucumeris*
Ambush	spray	harmful (36)	harmful (30)	harmful (30)
Benomyl	spray	negligible	harmful	harmful
Botran	spray	negligible	negligible	negligible
Bravo	spray	negligible	negligible	negligible
Captan	spray	negligible	negligible	harmful (7)
Diazinon	soil drench	harmful (14)	negligible	harmful (7)
Dibrom	fumigant	harmful (7)	harmful (7)	harmful (7)
Dichlorvos	fumigant	harmful (2)	harmful (2)	harmful (2)
Dipel	spray	negligible	negligible	negligible
Insecticidal soap	spray	harmful (adults)	harmful (0)	harmful (0)
Kelthane	spray	harmful (14)	harmful (4)	harmful (4)
Lannate	spray	harmful (31)	harmful (14)	harmful (30)
Lindane	spray	harmful (14)	harmful (7)	harmful (20)
Malathion	spray	harmful (14)	harmful (14)	harmful (14)
Mancozeb	spray	negligible	negligible	harmful
Maneb	spray	negligible	negligible	negligible
Micro-niasul	spray	negligible	negligible	negligible
Nicotine	fumigant	harmful	negligible	negligible
Parathion	fumigant	harmful (14)	harmful (7)	harmful (7)
Petroleum oil	spray	harmful (0)	harmful (0)	harmful (0)
Rovral	spray	negligible	harmful (7)	harmful
Sevin	spray	harmful (14)	harmful (7)	harmful (7)
Sulphur	dust	negligible	negligible	harmful
Sulphur	fumigant	negligible	negligible	negligible
Tedion	fumigant	negligible	negligible	negligible
Thiodan	spray	harmful (20)	harmful (7)	harmful (7)
Thiodan	drench	harmful (2)	negligible	harmful (2)
Vendex	spray	negligible	negligible	negligible

Note: () Residual toxicity to bio-control agent in days at 20°C e.g. Insecticidal soap is listed as "harmful, adults (0)", so sprays of this pesticide will only kill adult stages of predators and parasites. It has "0" days residual toxicity so bio-controls could be re-introduced the same day without harm.

References -

1. B.C. Dept. Agric. Nursery, Greenhouse Vegetable and Ornamental Production Guide 1988/89.
2. Steiner and Elliott, Biological Pest Management for Interior Plantscapes, AEC, Vegreville 1987.

INTERIOR PLANTSCAPES AND HOUSE PLANTS

M. Steiner and J. McCullough

The following use patterns are in accordance with labels on domestic class products registered for use on house plants and in interior plantscapes for ornamentals. Rates are given in terms of commonly available formulated products.

All chemicals may be phytotoxic to some plants or plant stages or under certain conditions. Consult label for additional information or refer to Alberta Agriculture Garden Fax leaflet 270/621-1 "Susceptibility of Some Ornamental Plants to Pesticide Injury". If in doubt, spray a small area first and wait 4-5 days for signs of injury. Move plants outdoors to treat where practical.

For larger greenhouses and atria, biological pest control may be a practical alternative. See references page 89.

APHIDS

Aphids

Cultural Control -

Use yellow sticky traps in greenhouses to catch incoming winged aphids. Screen windows and vents to exclude them. Prune off heavily infested growth.

Chemical Control -

Product	Rate	Comments
Soap 2% solution	Ready to use	Ensure thorough coverage. Repeat as necessary.
Soap 50.5% solution	20 ml/L	Ensure thorough coverage. Repeat as necessary.
Malathion 50% EC	1-2 ml/L	Repeat at 7-14 day intervals as necessary.
Resmethrin 1% solution	Ready to use	Spray foliage, repeat as necessary.
Resmethrin 0.25% aerosol	Ready to use	Spray at minimum 50 cm distance from foliage. Repeat as necessary.
Resmethrin 0.2% + allethrin 0.125% aerosol	Ready to use	Spray at minimum 50 cm distance from foliage. Repeat as necessary.
Resmethrin 0.25% + tetramethrin 0.25% aerosol	Ready to use	Spray at minimum 50 cm distance from foliage. Repeat as necessary.

CYCLAMEN MITE

Cyclamen mite

Cultural Control -

This mite likes high humidity. Move infested plants to drier cooler area.

Chemical Control -

Product	Rate	Comments
Dicofol 18.5% EC	2 ml/L	Ensure thorough coverage, particularly of new growth.
Dicofol 0.46%	Ready to use	Ensure thorough coverage, particularly of new growth.
Dicofol 3.9% EC	5 ml/L	For African violets.
Resmethrin 0.25% + tetramethrin 0.25% aerosol	Ready to use	Spray at minimum 50 cm distance. Repeat as necessary.

Restrictions -

Dicofol 18.5% EC: Greenhouse registration only.

FUNGUS GNATS

Fungus gnats

Cultural Control -

Wet soil high in organic matter favours fungus gnats. Allow soil to dry between watering. Remove rotting leaves and roots and repot if necessary in sterilized soil. A thin layer of sand or pebbles on the soil surface will discourage them.

Chemical Control -

Product	Rate	Comments
Chlorpyrifos 0.5% dust	Ready to use	Dust on soil surface for larvae.
Diazinon 2% dust	Ready to use	Dust on soil surface for larvae. Work into top 3-5 cm and water in thoroughly.
Pyrethrins 0.25%	Ready to use	Mist around foliage and use as a space spray for adults.

Restrictions -

Chlorpyrifos: If possible, remove plants outside for treatment. Do not repeat more than once every two months.

MEALYBUGS

Mealybugs

Cultural Control -

Prune off heavily infested foliage. Mist plants frequently. Remove large mealybugs before they lay white fluffy egg masses. Check roots if infestation persists.

Chemical Control -

Product	Rate	Comments
Chlorpyrifos 0.5% dust	Ready to use	Dust foliage and soil surface.
Soap 2% solution	Ready to use	Ensure thorough coverage. Repeat as necessary.
Soap 50.5% solution	20 ml/L	Ensure thorough coverage. Repeat as necessary.
Malathion 50% EC	2 ml/L	Spray foliage. Repeat at 7-14 day intervals as necessary.
n-propanol (rubbing alcohol)	Ready to use	Dab on insects, avoiding contact with plants.

Restrictions -

Chlorpyrifos: If possible, remove plants outside for treatment. Do not repeat more than once every two months.

MILLIPEDES

Millipedes

Cultural Control -

Repot in sterilized potting soil after washing off roots. In greenhouses, clean up benches and floor areas.

Chemical Control -

Product	Rate	Comments
Chlorpyrifos 0.5% dust	Ready to use	Dust soil surface and water in.
Diazinon 2% dust	Ready to use	Dust soil surface, mix into top 3-5 cm and water thoroughly.

Restrictions -

Chlorpyrifos: If possible, remove plants outside for treatment. Do not repeat more than once every two months.

SCALES

Scales

Cultural Control -

Prune off heavily infested foliage. Hand pick large scales. Mist foliage frequently.

Chemical Control -

Product	Rate	Comments
Chlorpyrifos 0.5% dust	Ready to use	Dust foliage.
Soap 2% solution	Ready to use	Ensure thorough coverage. Repeat as necessary.
Soap 50.5% solution	20 ml/L	Ensure thorough coverage. Repeat as necessary.
Malathion 50% EC	1-2 ml/L	Spray foliage. Repeat at 7-14 day intervals as necessary.

Restrictions -

Chlorpyrifos: If possible, remove plants outside for treatment. Do not repeat more than once every two months.

SLUGS AND SNAILS

Slugs and Snails

Cultural Control -

Remove debris, weeds, boards, etc. from greenhouse floors and benches. Keep floor dry.

Chemical Control -

Product	Rate	Comments
Metaldehyde 6.5% bait	Ready to use	Wet soil down first. Scatter or place in piles. Use fresh bait.
Methiocarb 2% bait	Ready to use	Scatter bait evenly.

Restrictions -

Metaldehyde, methiocarb: Greenhouse registration only. Keep pets away.

SPIDER MITES

Spider mites

Cultural Control -

Mist underside of leaves frequently and avoid hot dry areas.

Chemical Control -

Product	Rate	Comments
Dicofol 18.5% EC	2 ml/L	Ensure thorough coverage of underside of leaves. Repeat at 7-14 days as necessary.
Dicofol 0.46% EC	Ready to use	Ensure thorough coverage of underside of leaves. Repeat at 7-14 days as necessary.
Soap	Ready to use	Ensure thorough coverage of underside of leaves. Repeat as necessary.
Soap 50.5% solution	20 ml/L	Ensure thorough coverage of underside of leaves. Repeat as necessary.
Malathion 50% EC	1-2 ml/L	Ensure thorough coverage of underside of leaves. Repeat at 7-14 day intervals as necessary.

Restrictions -

Dicofol 18.5% EC: Greenhouse registration only.

SPRINGTAILS

Springtails

Cultural Control -

Allow soil to dry between watering. Most species are harmless and do not require control.

Chemical Control -

Product	Rate	Comments
Diazinon 2% dust	Ready to use	Dust soil surface. Work into top 3-5 cm and water in thoroughly.

THRIPS

Thrips

Cultural Control -

Increase humidity and avoid high temperatures. Mist plants frequently. Keep cut garden flowers away from house plants as they are frequently infested.

Chemical Control -

Product	Rate	Comments
Chlorpyrifos 0.5% dust	Ready to use	Dust foliage and soil surface.
Malathion 50% EC	1-2 ml/L	Spray foliage, particularly growing tips. Repeat at 7-14 day intervals as necessary.
Pyrethrins 0.25% aerosol	Ready to use	Spray at minimum 50 cm distance from foliage. Repeat as necessary.
Resmethrin 1% solution	Ready to use	Spray foliage. Repeat as necessary.

Restrictions -

Chlorpyrifos: If possible, remove plants outside for treatment. Do not repeat more than once every two months.

WHITEFLIES

Whiteflies

Cultural Control -

Hang yellow sticky traps in greenhouses to trap adults.

Chemical Control -

Product	Rate	Comments
Chlorpyrifos 0.5% dust	Ready to use	Dust underside of leaves
Soap 2% solution	Ready to use	Ensure thorough coverage of underside of leaves.
Soap 50.5% solution	20 ml/L	Ensure thorough coverage of underside of leaves.
Malathion 50% EC	1 - 2 ml/L	Spray foliage. Repeat at 7-14 day intervals as necessary.
Pyrethrins 0.25% aerosol	Ready to use	Spray at minimum distance of 50 cm from foliage. Repeat as necessary (adults only).

Resmethrin 1% solution	Ready to use	Spray at minimum distance of 50 cm from foliage. Repeat as necessary (adults only).
Resmethrin 0.25%	Ready to use	Spray at minimum aerosol distance of 50 cm from foliage. Repeat as necessary (adults only).
Resmethrin 0.25% + tetramethrin 0.25% aerosol	Ready to use	Spray at minimum distance of 50 cm from foliage. Repeat as necessary (adults only).

Restrictions -

Chlorpyrifos: If possible, remove plants outside for treatment. Do not repeat more than once every two months.

References -

1. Compendium of Pest Control Products Registered in Canada 1989. (Microfiche)
2. Alberta Agriculture Garden Fax Leaflet 270/621-1, "Susceptibility of Some Ornamental Plants to Pesticide Injury".
3. Pest Problems in Small Greenhouses and Indoor Plantings, Province of British Columbia. 1982.
4. Steiner and Elliott, "Biological Pest Management for Interior Plantscapes", Alberta Environment Centre, Vegreville, Alberta. 1987.

MUSHROOMS

R.S. Vernon

MUSHROOM FLIES

Mushroom flies - sciarid, phorid & cecid flies

LOADING TO COOL-DOWN

Chemical Control -

Active Ingredient	Rate (g AI/100 m^2)
*Diazinon	25-50
*Dimethoate	30

*Apply in 5L H_2O/100 m^2 to interior walls and floor. If ceiling is sprayed, protect top beds with polyethylene film. Do not spray compost. Brush on support posts and side boards.

In addition to the above, use one of the following as a fog:

Active Ingredient	Rate (g AI/100 m^2)
*Dichlorvos	1
*Pyrethrin	.58

*Do not fog directly on beds. Ventilate after 1 hour exposure.

SPAWNING THROUGH CASING

Chemical Control -

Active Ingredient	Rate (g AI/100 m^2)
*Diazinon	25-50

*Apply in 5L H_2O/100 m^2 to walls, ceiling, floor, support posts, and outsides of bed boards immediately after spawning. Protect compost beds with polyethylene film. Repeat immediately after casing but do not spray ceiling, support posts, or bed boards. Brush on support posts and bed boards. Do not spray compost or casing soil.

In addition to the above, use one of the following as a fog:

Active Ingredient		Rate (g AI/100 m^2)
*Dichlorvos		1
*Pyrethrin		.58
*Dichlorvos:	Do not apply later than 1 day after casing. Ventilate after 1 hour exposure. Do not fog directly on beds.	
*Pyrethrin:	Apply twice weekly or as required. Ventilate after 1 hour exposure. Do not fog directly on beds.	

and one of the following:

Active Ingredient	Rate (g AI/100 m^2)
*Malathion (dust)	12-15
*Malathion (WP)	12.5-18.7
*Pyrethrin (dust)	.09
+Methoprene (EC)	105

Notes: * To obtain good control, even coverage is essential. Apply twice weekly or as required.
+ Incorporate in casing at time of casing. Make application evenly and mechanically mix into casing material prior to casing operation; or drench evenly onto the surface of the casing immediately after placement.

PRODUCTION

Chemical Control -

Active Ingredient	Rate (g AI/100 m^2)
*Malathion	12-15
+Malathion	12.5-18.7
++Pyrethrin	.09

Notes: * To obtain good control, even coverage is essential. Apply before or after flush, twice weekly, or as required. Do not apply within 2 days of harvest.
+ Spray bed surface. Apply before first pinning and between breaks. Apply twice weekly or as required. Do not apply within 2 days of harvest.
++ To obtain good control, ensure even coverage. Apply every 3 days or as required. Do not apply within 1 day of harvest.

In addition to the above, use the following as a fog:

Active Ingredient	Rate (g AI/100 m^2)
*Pyrethrin	.58

Notes: * Apply twice weekly or as required. Ventilate after 1 hour exposure. Do not fog directly on beds. Do not apply within 1 day of harvest.

MITES

Mites
Chemical Control -

Active Ingredient	Rate (g AI/100 m^2)
*Malathion (WP)	12.5-18.7

Spray bed surface. Apply as required but not within 2 days of harvest.

BERRY CROPS

H. Gerber and R.S. Vernon

CAUTION: Most insecticides are toxic to bees. See page 122 "Insecticide Use and Bee Safety" before spraying berry crops.

APHIDS

Aphids
Chemical Control -

Active Ingredient	Rate	Preharvest Interval	References
Malathion 50% EC	1.6 mL/L	3	-
Rotenone	1% dust	-	-
Oxydemeton-methyl 24% SC	2.33 L/ha	40	1

Restrictions -

Malathion: Do not apply at air temperatures below 20°C.

References -

1. Raworth and Clements, Agric. Can., 1988

CHOKECHERRY FRUIT INSECTS

Chokecherry fruit insects
Chemical Control -

Active Ingredient	Rate	Preharvest Interval	References
Trichlorfon 4 EC	25 mL/100 L	*	1

*Apply insecticides between start and completion of petal fall. Controls both midge and sawfly. Apply spray when most petals have fallen.

See Appendix I re other insecticides tested for control of fruit insects.

References -

1. Drouin and Kusch, NFRC, Edmonton, Inf. Rep. NOR-X-81, 1974; NOR-X-150,1976; NOR-X-184,1977; NOR-X-213, 1979; NOR-X-227,1980.

CURRANT FRUIT FLY

Currant fruit fly (currant & gooseberry)
Chemical Control -

Active Ingredient	Rate	Preharvest Interval	References
Malathion 50% EC	1.6 mL/L	3	1,2
Methoxychlor 25% EC	7.8 mL/L	14	1

Apply spray when most of petals have fallen and repeat in 10 days.

Restrictions -
Malathion: Do not apply at air temperatures below 20°C.

References -

1. Richardson and Andison, Agric. Can., Pub. 1143,1967.
2. B.C. Dept. Agric., Pub. 74-75,1974.
3. Drouin and Kusch, NFRC, Edmonton, Inf. Rep. NOR-X-227, 1980.

LEAFROLLERS

Leafrollers (strawberry & raspberry)
Chemical Control -

Active Ingredient	Rate	Preharvest Interval	References
Malathion 50% EC	1.6 mL/L	3	1

Apply spray at first sign of damage and repeat as necessary.

Restrictions -
Malathion: Do not apply at air temperatures below 20° C.

References -

1. B.C. Dept. Agric., Pub. 74-75, 1974.

MITES

Mites (raspberry & other fruits)
Chemical Control -

Active Ingredient	Rate	Preharvest Interval	References
Cyhexatin (strawberries)	75-100 mL/100 L	see label	3
DicofoL 18.5% EC	1.6 mL/L	see label	1,2
Malathion 50% EC	1.6 mL/L	see label	
Tetradifon 10% EC	1.6 mL/L	see label	1
Fenbutatin-oxide 50 WP	25 mL/100 L	see label	3

Restrictions -

Observe the wait period shown on the label for the specific crop.
Malathion: Do not apply at air temperatures below 20°C.

References -

1. Agric. Can., Pub. 880, 1964.
2. B.C. Dept. Agric., Pub. 74-75, 1974.
3. Pest. Res. Rep. 1975; 1976; 1977.

RASPBERRY CROWN BORER

Raspberry crown borer
Chemical Control -

Active Ingredient	Rate	Preharvest Interval	References
*Azinphos-methyl	1125-2250 mL AI/725 L/ha		
Diazinon 12.5% EC	7.8 mL/L	N/A	1,2

*Commercial applications only.

Restrictions -

Azinphos-methyl: Apply to lower portion of canes and crowns using 1800 L water/ha. Rates up to 1.1 kg/ha may be applied within 3 days of harvest. Rates over 1.1 kg/ha should be applied only before fruit set or after harvest.

Diazinon: Apply as a drench to the crown area using 0.6 L of mixture, plant in October or in early spring when new shoots are about 10 cm high.

References -

1. B.C. Dept. Agric. Pub. 74-75,1974.
2. Raine, Agric. Can., Pub. 1268,1966.

RASPBERRY FRUITWORM

Raspberry fruitworm
Chemical Control -

Active Ingredient	Rate	Preharvest Interval	References
Rotenone 40% WP	25 g/5 L	N/A	1

Apply when berries start to form.

References -

1. Manitoba Dept. Agric. Pub. 74-75, 1974.

RASPBERRY SAWFLY, IMPORTED CURRANTWORM

Raspberry sawfly, Imported currantworm
Chemical Control -

Active Ingredient	Rate	Preharvest Interval	References
Diazinon 12.5% EC	7.8 mL/L	Prebloom	1
Rotenone	1% dust	-	-

References -

1. B.C. Dept. Agric., Pub. 74-75, 1974.

STRAWBERRY CUTWORM

Strawberry cutworm (commercial strawberries)
Cultural Control - Do not disc-in old stands until after 1 September.

Chemical Control -

Active Ingredient	Rate (g AI/ha)	Preharvest Interval	References
chlorpyriphos	550	*	1,2

*Apply in 2000 L/ha as a band treatment between 1-15 June.

References -

1. Askew et al., Pest. Res. Rep. 1978:68.
2. Ayre, Agric. Can., Winnipeg. In press.

SAWFLIES - deltamethrin

STRAWBERRY ROOT WEEVIL

Strawberry root weevil
Chemical Control -

Active Ingredient	Rate	Preharvest Interval	References
Malathion 50 EC	7.8-11.7 mL/L	Prefruiting	1,2

Note: Use the lower rate in spring when fresh leaf notching seen. The higher rate may be used after fruit is harvested.

Restrictions -

Malathion: Do not apply at air temperatures below 20°C.

References -

1. B.C. Dept. Agric., Berry Prod. Rec. 1970.
2. Compendium on Reg. Uses of Pesticides.

SHELTERBELTS, ORNAMENTAL TREES AND SHRUBS

G.B. Neill and H.F. Cerezke

The establishment of economic threshold guidelines for control of insect and mite pests of shelterbelts, ornamental trees, and shrubs is highly subjective but can be defined in general terms on the basis of the number of insects required to affect mortality of the host plant or of the number of insects required to inflict a specified level of visual damage. Single plantings of trees and shrubs are grown mainly for their aesthetic value and cannot tolerate severe weakening; the aesthetic appearance of shelterbelts, on the other hand, is likely to be of secondary value. We suggest, therefore, that economic thresholds be restricted at this time to single plantings and that tolerance limits be based on the number of insects likely to cause easily visible damage. Since published data on this aspect are rare, some examples of arbitrary thresholds are presented below for a few insects to serve as a rough guideline. At these suggested levels, insecticidal treatment may be applied to prevent the development and spread of damage.

Ornamental trees, shrubs, and shelterbelts are frequently situated adjacent to fruit and vegetable gardens, field crops, pastures, and open water. Therefore, care must be exercised when spraying with all chemical insecticides to reduce or prevent contamination by spray drift.

The following recommendations with designated dosages are given as *active ingredient* and using high-pressure spray equipment unless otherwise specified. *Follow label instructions explicitly for correct dosage, coverage, timing of spray, and to avoid phytotoxic effects.*

APHIDS

Aphids (General, open-feeding)

Chemical Control -

Active Ingredient	Rate (AI)	References
Deltamethrin	4.5 g/100 L	6,7
Diazinon EC	50 g/100 L	1,2
Dimethoate	see label	1,2,6,7
*Dutox	50 g/100 L	1
Malathion	50 g/100 L	1,2,5,6,7
Permethrin EC	6-9 g/100 L	1,3,4,5
Pirimicarb	25 g/100 L	6,7
Pyrethrins PS	0.2%	-

*Formulated, trichlorfon + oxydemeton-methyl

Restrictions -

Dimethoate: May be toxic to *Amelanchier, Prunus,* and *Ulmus* spp. (1)

Malathion: Do not apply at air temperatures below 20°C.

References -

1. Drouin and Kusch, NFRC, Edmonton. Inf. Rep. NOR-X-81, 1974; NOR-X-131, 1975; NOR-X-150, 1976; NOR-X-184, 1977; NOR-X-213, 1979; NOR-X-227, 1980.
2. Kusch, NFRC, Edmonton, Pest Leaflet 10-76, 1978.
3. Howe and Worden, PFRA, Indian Head, Ann. Rep. 1977.
4. Neill and Worden, PFRA, Indian Head, Ann. Rep. 1978.
5. Neill, PFRA, Indian Head, Ann. Rep. 1980.
6. Reynard and Neill, PFRA, Ind. Head, Pest. Res. Rep. 1986:165.
7. Reynard and Neill, PFRA, Indian Head, Pest Res. Rep. 1986: 170.

ASH PLANT BUGS

Ash plant bugs

Chemical Control -

Active Ingredient	Rate (AI)	References
Carbaryl WP	1.25 g/L	1
Resmethrin 0.25% pressurized spray		

References -

1. Neill and Eckstein, PFRA, Indian Head, Ann. Rep. 1984.

ASPEN BORER

Aspen borer, *Saperda calcarata*

See POPLAR BORER on ASPEN (page 104).

BIRCH LEAFMINERS

Birch leaf-mining species

See LEAFMINERS (page 103).

BLISTER BEETLES

Blister beetles

Chemical Control -

Active Ingredient	Rate (AI)	References
Carbaryl WP	1.25-1.6 g/L	1
Deltamethrin EC	1.5 g/100L	1

References -

1. Neill and Reynard, PFRA, Indian Head, Ann. Rep. 1985.

BOXELDER BUG

Boxelder bug

Chemical Control -

Active Ingredient	Rate (AI)	References
Carbaryl WP	1.25-1.6 g/L	1,2,3,4
*Trichlorfon SN	1.25 g/5L	1

*Commercial use only.

References -

1. Mazurek et al., Proc. Entomol. Soc. Ont. 92:202, 1961.
2. Neill and Worden, PFRA, Indian Head, Ann. Rep. 1980.
3. Neill and Worden, PFRA, Indian Head, Ann. Rep. 1981.
4. Reynard and Neill, PFRA, Indian Head, Pest. Res. Rep.1988:162.

BOXELDER TWIG BORERS

Boxelder twig borers

Chemical Control -

Active Ingredient	Rate (AI)	References
Dimethoate EC		
Soil drench	5.6 g/cm basal diam.	1
Foliar spray	50 g/100 L	1
Malathion EC		
Foliar spray	50 g/100 L	1

Notes - Soil drench application: Apply in mid-May to soil around the drip line. Water-in well. Foliar applications: Apply in late July.

Restrictions -

Malathion: Do not apply at air temperatures below 20°C.

Reference -

1. Drouin and Kusch, NFRC, Edmonton, Inf. Rep. NOR-X-131, 1975; NOR-X-184, 1977.

BRONZE BIRCH BORER

Bronze birch borer

Cultural Control -

Maintain birch in a healthy state by proper watering, fertilizing, and control insects such as birch leaf miners. Infested trees showing advanced top and branch kill should be removed and destroyed during late fall to spring. On trees showing early signs of die-back and decline, prune 30-50 cm below all dead branches and tops in late fall and destroy.

Chemical Control -

Active Ingredient	Rate (AI)	References
*Lindane EC	43 g/L water	1,2

***Note:** Make application of lindane during mid- to late-June. Recommended application methods - painting bark on the lower stem, foliar spray, and injecting into borer holes - are likely to give only partial control because of the attack behaviour of the insect(1,2).

References -

1. Ball and Simmon, J. Arboriculture 6:309-314.1980.
2. Barter, Can. Entomol. 89:12-36.1957.

CARPENTER WORMS and ASH BORER

Carpenter worms & Ash borer

Cultural Control -

Damaged areas may be wrapped with burlap to prevent emergence of adults. (1)

References -

1. Peterson, PFRA, Indian Head, Sask., TN Pamphlet 2, 1971.

ELM BARK BEETLES

Elm bark beetle, native species
Control of Dutch elm disease (DED) and the native elm bark beetle vector is achieved by an integration of several control methods:

Cultural Control -

Sanitation: Remove and destroy (by chipping, burning, or burying in mineral soil) diseased, dying or recently killed elm trees, broken and dead branches and stumps with bark present to ground level. Trees salvaged for lumber or other wood products should not be stored with bark on or between April l and December 1. Avoid transport of infected material for firewood. Keep elms healthy by maintaining proper watering, fertilizing, insect control and pruning. (1,4)

Chemical Control -

Active Ingredient	Rate (AI)	References
*Chlorpyrifos EC	0.5% aqueous solution	l,2,4
Methoxychlor	4-12% solution	3

*Application of chlorpyrifos is by commercial use only. Thoroughly spray the lower 2.5 m of the trunks of living elms until the bark is wet in late summer to exclude over-wintering beetles from a D.E.D. control area. Spray the entire crowns of living elms in late-April to mid-May to give single season protection against branch feeding by adult beetles.

References -

1. Euale et al., GLFRC, Sault Ste. Marie. Inf. Rep. O-X-307, 1980.
2. Gardiner and Webb, GLFRC, Sault Ste. Marie, Inf. Rep. O-X-311, 1980.
3. Hildahl, NFRC, Winnipeg. Blue Jay, 35(2): 67,1977.
4. Hildahl, and Jeffrey, Man. Dept. Natl. Resources Publ., 1980.

CANKERWORMS

Fall cankerworm & Spring cankerworm

Economic Threshold -

Control on first evidence of small "shot-holes" appearing on one or more branches.

Cultural Control -

Costruct Tanglefoot tree bands around trunk before 1 April for spring cankerworms and before 25 September for fall cankerworms to prevent wingless females from ascending the tree to lay eggs(l,2,4).

Biological Control -

Agent	Rate	References
Bacillus thuringiensis var. *kurstaki* SU	0.02-1.1 billion I.U. /4.5 L or 8000 I.U./mg	1,3

Chemical Control -

Active Ingredient	Rate (AI)	References
Carbaryl	1.25-1.6 g/L	1,2,3
Methoxychlor EC	100 g/100 L	-

References -

1. Hildahl and Peterson, NFRC, Edmonton, Inf. Rep. NOR-X-100, 1974
2. Hildahl, NFRC, Edmonton, Pest Leaflet 3-75, 1975.
3. Reynard and Neill, PFRA, Indian Head, Pest. Res. Rep. 1988:164.

FOREST TENT CATERPILLAR

Forest tent caterpillar
See TENT CATERPILLAR - (page 110)

LEAF BEETLES

Leaf beetles - Elm, poplar, and willow leaf beetles

Chemical Control -

Active Ingredient	Rate (AI)	References
Carbaryl WP	1.25-1.6 g/L	1
Deltamethrin EC	1.5 g/100L	1

References -

1. Reynard and Neill, PFRA, Indian Head, Pest. Res. Rep.1985:209.

LEAFHOPPERS and PSYLLIDS

Leafhoppers & Psyllids

Chemical Control -

Active Ingredient	Rate (AI)
Carbaryl WP	1.25-1.6 g/L
Malathion EC	50 g/100 L
Methoxychlor EC	75 g/100 L
Pyrethrins PS	0.2%

Restrictions -

Malathion: Do not apply at air temperatures below 20°C.

Pyrethrins: Do not apply in direct sunlight, avoid wetting, and never spray food crops.

LEAFMINERS

Leafminers - Birch leaf miner species, Lilac leaf miner, Oak leaf miner

Economic Thresholds for Birch Leafminers -

Single season treatment may be desirable when 1 damaged leaf/branch tip of first generation (early June) is observed or two seasonal treatments if 1 or more leaves are mined/branch tip in previous year. Three seasonal treatments may be necessary when all 3 leafminer species are present.

Chemical Control -

Active Ingredient	Rate (AI)	References
Acephate EC (birch)	25 g/100 L	1,3
Carbaryl WP (birch, oak)	50 g/100 L	-
Diazinon EC	50 g/100 L	2
Dimethoate	Follow label	1-3
Malathion EC	50 g/100 L	2

Birch leafminers: Dimethoate for soil drench treatment is applied at 4.5-5.6 g/cm of stem diameter and watered-in well according to label instructions. Apply bark paint-on treatment of dimethoate when first new leaves open fully (about 3rd week of May); repeat application about mid-June for control of second generation, painting the insecticide either above or below the first treatment. In areas where the two late-summer leaf mining species are also present, a third application in mid-July is required (1). On foliage, make first application when leaves are fully open; repeat about mid-June and again in early July. Phytotoxicity of leaves may occur from soil drench treatment if not watered in well.

Lilac Leafminer: Treat when damage first seen.

Oak leafminer: Treat when damage first seen.

Restrictions -

Malathion: Do not apply at air temperatures below 20°C.

References -

1. Drouin and Kusch, NFRC, Edmonton, Inf. Rep. NOR-X-205, 1978; NOR-X-213, 1979; NOR-X-227, 1980.
2. Kusch, NFRC, Edmonton, Pest Leaflet 9-76,1976.
3. Wong and Drouin, NFRC, Edmonton, Pest Leaflet 1-74, 1974.
4. Knowles and Beaubien, Pest. Res. Rep., 1982.

MOUNTAIN PINE BEETLE

Although Mountain pine beetle is primarily a pest in pine forests, it may also invade urban, park and agricultural areas and infest ornamental, shade and shelterbelt-planted pines. Carbaryl 2% SN in water and MSM arsenic (systemic herbicide) are presently registered; the former for protection of high-value trees, the latter to kill bark beetle broods under the bark. However, proper application methodology is detailed and specific, and requires familiarity with the beetle to ensure success. Information on protection and control can be obtained through the Forestry Canada (Pacific Forestry Centre, Victoria, B.C. or Northern Forestry Centre, Edmonton, Alta.).

NORTHERN PITCH TWIG MOTH

Northern Pitch twig moth

Cultural Control -

Remove resinous nodules manually on the main stem and destroy the single larvae that each contains.

PEAR SLUG

Pear slug

Economic Threshold -

Control when each of 5 leaves examined in late July contains one or more immature larvae.

Cultural Control -

Larvae can be removed from leaves with a strong jet of water from a garden hose. Effective control is also achieved by rinsing with a soapy solution. (1)

Chemical Control -

Active Ingredient	Rate (AI)	References
Acephate EC	25g/100 L	2
Carbaryl WP	25 g/100 L	1,2
Malathion EC	37-50 g/100 L	1,2
Pyrethrin	Pressurized spray	1
Rotenone	1% dust	1

Restrictions -

Malathion: Do not apply at air temperatures below 20°C.

References -

1. Drouin, NFRC, Edmonton, Pest Leaflet 2-75, 1978.

2. Drouin and Kusch, NFRC, Edmonton, Inf. Rep. NOR-X-150, 1976; NOR-X-184, 1977; NOR-X-205, 1978.

POPLAR BORER ON ASPEN

Poplar borer on aspen (*Saperda calcarata*)
Borer infestations tend to vary directly with stem diameter and inversely with stocking of aspen stands (2,3). Infestations may concentrate in "brood trees" as larval tunnels increase annually (3). These provide infection courts for disease-causing fungi, especially Hypoxylon canker, and ultimately enhance the risk of stem breakage by wind (l,3). The poplar borer may be associated with carpenter worms (2). No chemicals are currently registered.

Cultural Control -

In small aspen woodlots or shelterbelts, peripheral heavily infested "brood trees" may be removed and destroyed before mid- June (2,3). Maintaining a heavy understory of other trees and shrubs appear to reduce risk of borer attacks. On trees with fresh sap exudate or boring frass, larvae in the wood can sometimes be killed by inserting a length of sharp flexible wire into the exit holes.

References -

1. Anderson and Martin, For. Sci. 27:461-476,1981.
2. Cottrell, Proc. Entomol. Soc. B.C. 59:33-34,1962.
3. Peterson, Ann. Rep. Entomol. Soc. Ont. 78:56-61,1945.

POPLAR BUD-GALL MITE

Poplar bud-gall mite
Cultural Control -

Thorough annual pruning and destroying of galls helps reduce populations. Future plantings should favour the more resistant varieties 'Walker', and 'Griffin' over the less resistant " Brooks #5 " and "Northwest". Trees provided with adequate moisture, weed control, and fertilization can tolerate infestations of mites and gall development without major effects. (l-3)

Chemical Control -

No chemicals registered.

References -

1. Drouin, NFRC, Edmonton, Pest Leaflet 13-76, 1976.
2. Howard, Alta. Hort. Res. Centre, Brooks, Crop Protection Newsletter 1977.
3. Howe, PFRA, Indian Head Tree Nursery, Ann. Rep., 1977.

SAWFLIES

Sawflies - (open-feeding defoliators)

Economic Threshold -

Larch: Control when 5 or more of current year shoots are curled on 3-m tall trees. Shoots will bear eggs or newly hatched larvae.

Spruce: Control when colonies of larvae are present on upper whorls of branches of trees, mostly less than 4 m tall.

Pine: Control when 10 or more colonies of larvae are present on trees up to 3 m tall.

Willow: Control when 10 or more colonies of larvae are present on shrubs up to 2 m tall.

Chemical Control -

Active Ingredient	Rate (AI)	References
Acephate EC	25 g/100 L	1
Carbaryl WP	25 g/100 L	5
Deltamethrin EC	0.9 g/100 L	5
Diazinon EC	25 g/100 L	1,4,5
Dimethoate	Follow label	1,3
*Dutox EC	25 g/100 L	1
Malathion EC	50 g/100 L	2,4,5
Permethrin	6-9 g/100 L	1
Trichlorfon EC	25 g/100 L	1

*Formulated oxydemeton-methyl and trichlorfon

Restrictions -

Malathion: Do not apply at air temperatures below 20°C.

References -

1. Drouin and Kusch, NFRC, Edmonton, Inf. Rep. NOR-X-184, 1977; NOR-X-205, 1978; NOR-X-227, 1980.
2. Hildahl and Peterson, Can. Forest. Serv., Winnipeg, MS-L-10, 1970.
3. Howe, PFRA, Indian Head, Ann. Rep. 1976.
4. Kusch, NFRC, Edmonton, Pest Leaflet 5-78,1975.
5. Reynard and Neill, PFRA, Indian Head, Pest. Res. Rep. 1987:173.

SCALE INSECTS

Scale insects - European fruit lecanium, Oystershell scale, Pine needle scale, & Scurfy scales

Economic Thresholds -

European Fruit Lecanium: Control when 25 or more scale insects attached/15 cm length of shoots.

Pine Needle Scale: Control when 1 or more branches has noticeable white scales on needles (i.e. one or more scales per needle of spruce and pine)

Chemical Control -

Active Ingredient	Rate (AI)	References
Carbaryl WP	1.25-1.6 g/L	1
*Diazinon EC	50 g/100 L	-
Dimethoate	50 g/100 L	1
Kinoprene	10 g/100 L	-
*Malathion EC	50 g/100 L	1-3
Permethrin EC	6-9 g/100 L	-
Dormant oil EC	25 g/L	2

*Registered for oystershell and scurfy scale; applications at 1 week intervals starting June 1. (2)

Apply any of the above except diazinon to control European fruit lecanium and pine needle scale when crawler stage present; 5-20 June and mid-August for pine needle scale and about mid-July for European fruit lecanium.

Restrictions -

Malathion: Do not apply at air temperatures below 20°C.

References -

1. Kusch, NFRC, Edmonton, Pest Leaflet 16-77,1977.
2. Peterson, Can. Entomol. 92:851,1960.
3. Peterson and DeBoo, Can. For. Serv., Winnipeg, Note L-5,1969.

SPIDER MITES

Spider mites - on spruce,larch, cedar and juniper.

Economic Threshold -

Control when foliage near the stem and in lower third of crown has Yellow-brown coloration and silken webbing plainly visible at close examination. Mite adults of green to brown coloration and 0.5 mm long should be visible to naked eye, especially against a white background.

Cultural Control -

Effective control can be achieved by flushing the affected foliage with a strong stream of cold water about every 14 days throughout the summer; this removes dead needles, webbing, dust and mite populations. Trimming the lower branches to increase light and air circulation will help to decrease mite buildup.

Chemical Control -

Active Ingredient	Rate (AI)	References
Diazinon EC	50 g/100 L	1,3

Dicofol EC	37 g/100 L	1,2,3
Fenbutatin oxide WP	25 g/100 L	1
Malathion EC	50 g/100 L	1,3

Apply at nozzle pressure of 2100 kPa or greater to penetrate webbing. Usually 2 sprays required in a season; the first application during third week of May, the second in late June or July. Control may be enhanced by using a different insecticide for second application.

Restrictions -

Malathion: Do not apply at air temperatures below 20°C.

References -

1. Drouin and Kusch, NFRC, Edmonton, Inf. Rep. NOR-X-150, 1976; NOR-X-213,1979; NOR-X-227,1980.
2. Peterson and Hildahl, Can. Forest. Serv., Winnipeg, L-7,1969.
3. Neill and Reynard, PFRA, Indian Head, Ann. Rep., 1984.

SPINY ELM CATERPILLAR

Spiny elm caterpillar

Chemical Control -

Active Ingredient	Rate
Malathion EC	50 g/100 L

Restrictions -

Malathion: Do not apply at air temperatures below 20°C.

SPRUCE BUDWORM

Spruce budworm

Economic Threshold -

On a 45-cm branch tip from mid-crown level of spruce, 6-10 spring emerged larvae are sufficient to cause potential damage to 25-50% of openly exposed new shoots. Damage caused by fewer larvae would be negligible because of natural larval mortality factors(2).

Biological Control -

Active Ingredient	Rate (AI)	References
Bacillus thuringiensis var. *kurstaki* WP	0.02-0.1 billion I.U./4.5 L or 8,000 I.U./mg	1,3,4

Apply *B. t.* after most of new shoots have flushed or lost their bud caps and larval development has reached peak third and fourth instars.

Chemical Control -

Active Ingredient	Rate (AI)	References
Deltamethrin	4.5 g/100L	5
Dimethoate EC	50 g/100 L	1
Methomyl (forestry use)	Follow label	1
Permethrin EC	6-9 g/100 L	-
Triclorfon 4 EC	Follow label	1,5

References -

1. Canusa, Data Fact Sheet, February 1982.
2. Cerezke, NFRC, Edmonton, File Rep., 1977.
3. Morris et al., FPMI, Sault Ste. Marie, Ont, Rep. FPM-X- 47,1981.
4. Morris et al., FPMI, Sault Ste. Marie, Ont, Rep. FPM-X- 53,1982.
5. Reynard and Neill, PFRA, Indian Head, Pest. Res. Rep. 1986:167.

SPRUCE GALL APHIDS

Spruce gall aphids

Economic Threshold -

Control required on spruce less than 3 m tall, when 10 brown galls were formed the previous year, or 2 or more branches bear numerous visible white cottony specks on the needles in the spring.

Cultural Control -

Remove the galls by hand as they are forming.

Chemical Control -

Active Ingredient	Rate (AI)	References
Carbaryl WP	1.25 g/L	1
Malathion 50	50 g/100 L	1

Apply insecticide in early May before bud break.

Restrictions -

Malathion: Do not apply at air temperatures below 20°C.

References -

1. Caltrell, NFRC, Edmonton, Pest Leaflet, 12-76, 1976.

TENT CATERPILLARS

Tent caterpillars

Economic Threshold (for Forest Tent Caterpillar) -

On trees up to 3 m tall, one egg band per tree (each band may contain 150-250 eggs), or, following egg hatch, one larval colony per tree. On trees of 7 cm or more stem diameter, 7 or more egg bands per tree.

Cultural Control -

On ornamentals, remove egg bands during late to early spring, or remove young larval colonies after hatch.

Biological Control -

Active Ingredient	Rate (AI)	References
Bacillus thuringiensis var. *kurstaki* SU	0.02-0.1 billion I.U./4.5 L 8,000 I.U. /mg	1,2,4,7

Chemical Control -

Active Ingredient	Rate (AI)	References
*Carbaryl WP	1.25-1.6 g/L	1,2,4,6
Deltamethrin	4.5 g/100 L	5,6
Diazinon EC	50 g/100 L	1
*Malathion EC	50 g/100 L	1,2,4,6
*Methoxychlor EC	50 g/100 L	1,2,4
Permethrin	6-9 g/100 L	-
Trichlorfon EC	50 g/100 L	1,3

*Registered for caterpillars on fruit trees.

Restrictions -

Malathion: Do not apply at air temperatures below 20°C.

Deltamethrin: For commercial use by ground in the Prairie Provinces and Peace River District of B.C . DO not use at temperatures above 25°C. Do not apply more than three times per season.

References -

1. Drouin and Kusch, NFRC, Edmonton, Inf. Ref. NOR-X-81, 1974; NOR-X-131,1974; NOR-X-150,1976; NOR-X-184, 1977; NOR-X- 205,1978.
2. Hildahl, Can. For. Serv., Winnipeg, Pest Leaflet 17-77,1977.
3. Hildahl and Bowden, NFRC, Winnipeg, File Report, 1976.
4. Hildahl and Campbell, Can. For. Serv., Winnipeg, Inf. Rep. NOR-X-135,1975.
5. Stephen, Pest. Res. Rep., 1984:211.
6. Reynard and Neill, PFRA, Indian Head, Pest. Res. Rep.1987:165.
7. Neill and Reynard, PFRA, Indian Head, Pest. Res. Rep.1989:149.

TERMINAL WEEVILS

Terminal Weevils (spruce and pine)

Cultural Control-

Remove and destroy infested terminals in early July and prune uppermost whorl of branches, leaving l of small diameter to develop into new leader. (l,2)

References -

1. Sundaram et al., CCRI, Ottawa, Inf. Rep. CC-X-31, 1972.
2. Turner et al., Ont. Min. Nat. Res., Pub. PC-3, 1975.

UGLY-NEST CATERPILLAR

Ugly-nest caterpillar

Cultural Control -

Destroy nests or tents containing larval colonies about the third week in May by pruning(l).

References -

1. Still, NFRC, Edmonton, Pest Leaflet ll-76,1976.

WARREN ROOTCOLLAR WEEVIL

Warren Rootcollar weevil

Cultural Control -

Grubs on root-collar base are located in resinous channels in the bark and can be readily removed by hand by first pulling away organic matter around tree and locating the galleries. Removal of organic litter around tree base discourages attacks. (l)

References -

1. Cerezke, NFRC, Edmonton, Inf. Rep., A-27,1970.

WILLOW SHOOT-BORING SAWFLY

Willow shoot-boring sawfly

Chemical Control -

Active Ingredient	Rate (AI)	References
Dimethoate	6.25 g/cm stem diam.	1,2

Apply as soil drench around willow plants and water in well.

References -

1. Drouin, NFRC, Edmonton, Pest Leaflet 24, 1978.
2. Drouin and Kusch, NFRC, Edmonton, Inf. Rep. NOR-X-150, 1976; NOR-X-184, 1977; NOR-X-205, 1978.

SEASONED WOOD AND TIMBER STRUCTURES

H.F. Cerezke

CARPENTER ANTS

Carpenter ants

Preventive Control -

Carpenter ant colonies may establish in stumps, unhealthy or dead trees, and in various interior and exterior buildings wood structures such as studs, rafters, baseboards, door casings and other support structures. Exterior decaying structures are particularly vulnerable and should be replaced. Outside stacked wood materials should be removed or examined annually for colony establishment, and not placed adjacent to buildings.

Chemical Control -

Active Ingredient	Rate	References
Carbaryl	5% dust	1
Diazinon	0.5%	1
Propoxur	1%	1
Resmethrin	0.25%	-

Locate and determine the extent of excavated cavities in wood structures from the small exuded piles of "sawdust", by "sounding", and by drilling fine holes. Inject or blow dust or sprays into holes near the top of cavities and into other cracks and crevices used as exit holes, or onto ant trails leading to and from the structure. Dusts are usually more effective than sprays.

References -

1. Agric. Can. Publ. 1736/E, 1982-1983.
2. Ostaff, East. For. Prod. Lab. Rep. OPX101E, 1974.
3. Ruppel, PFRC, Victoria For. Pest Leaflet No. 58,1973.

POWDERPOST BEETLES

Dry, seasoned, manufactured and unrotted coniferous and hardwoods may be attacked by a variety of species of Powderpost beetles which are more commonly in coastal B.C. areas than in the interior or prairie provinces. Most occurrences are in hardwoods in furniture, flooring, decorative trim, carved ornaments and other exotic wood products. Small circular holes and fine boring sawdust are diagnostic signs.

Cultural Control -

Expose infested material to heat (above 60°C) or to freezing temperatures for several hours. Unfinished material can be protected by varnishing, painting, coating with linseed oil or wax, or by using acceptable wood preservatives. Heavily infested material should be destroyed or replaced.

References -

1. Furniss and Carolin, USDA Misc. Publ. No. 1339,1977.
2. Ruppel, Pass and Wiens, PFRC, Victoria, Publ. FPL29, 1975.

SAWYER BEETLES

Sawyer beetles attack newly killed or severely weakened coniferous trees, mostly within the first year following death. The larvae bore tunnels into the wood and may be present for one to three years.

Preventive Control -

Process newly cut logs into lumber or other wood products within a few months after cutting. Remove bark of fresh-killed trees by early June.

Direct Control -

Expose infested logs to 60-71°C for two or more hours.

Chemical Control -

Active Ingredient	Rate
Lindane EC	0.4% solution

Apply lindane to entire bark surface in early June to prevent egg laying, and to kill eggs and young larvae, already present.

References -

1. Cerezke, NFRC Rep. NOR-X-129,1975.
2. Ostaff and Cech, East, For. Prod. Lab. Rep. OPX200E, 1978.

TERMITES

Pacific dampwood termite & Western subterranean termites feed in wood structures, especially coniferous materials and may eventually cause weakening or collapse of the structure. Favoured locations include: coniferous forests; dead trees; stumps, logs, or various wood structures; and partially decayed or mechanically damaged wood material in contact with the ground or moist substrate.

Preventive Control -

Clear stumps or piled wood away from buildings. Maintain dry soil conditions under and around buildings by clearing debris to increase ventilation. All wood support structures should not be in direct contact with moist soil, or should be treated with appropriate wood preservatives. Outside wooden structures such as fences, sidewalks, etc., should be separated from houses and other buildings. Maintain annual inspection for evidence of the presence of termites.

References -

1. Ruppel, PFRC, Victoria, For. Pest. Leaflet No. 57, 1972.

TURF

M. Dolinski

Recommendations for lawns and recreational areas not grazed by livestock.
Important: Mow the lawn before treatment.

ANTS

Ants
Chemical Control -

	Rate (g AI/100 m²)
Carbaryl	90-125/140-180 L
Chlorpyrifos (Commercial)	10
Diazinon	40-75/45-90 L

Restrictions -

Carbaryl:	Do not water for 2 days after treatment and repeat in 2-3 weeks if necessary.
Chlorpyrifos:	Thoroughly water the lawn after treatment.
Diazinon:	See chlorpyrifos.

EARTHWORMS

Earthworms
Chemical Control -

	Rate (g AI/100 m²)	References
Carbaryl	125	1-3

Apply uniformly in 90 L of water then water thoroughly.

References -

1. Doane, J. Econ. Entomol. 55:3,1962.
2. Peterson, Pest. Res. Rep. 1964:151.
3. McDonald, Pest. Res. Rep. 1971:202.

GLASSY CUTWORM

Glassy cutworm
Chemical Control -

	Rate (g AI/100 m^2)
Chlorpyrifos	10
Diazinon	30

Restrictions -
Only 2.5% chlorpyrifos granular, a commercial product, is registered for this purpose.

SOD WEBWORM

Sod webworm
Chemical Control -

	Rate (g AI/100 m^2)
Carbaryl	90-125
Chlorpyrifos	40-75
Diazinon	10

Restrictions -

Carbaryl:	Do not water in.
Chlorpyrifos:	Do not water for 12-24 hours after treatment.
Diazinon:	Water in well.

WHITE GRUB

White grub
Chemical Control -

	Rate (g AI/100 m^2)
Chlorpyrifos	10
Diazinon	75

Apply treatment between late July and early October.

Restrictions -
Chlorpyrifos: Keep off lawns until dry. Some formulations require watering after treatment.

WAREHOUSE AND FARM STORED GRAIN

N.D.G. White

WAREHOUSE INSECTS

Confused flour beetle, Dermestid beetles, Hairy spider beetle, Merchant grain beetle, Red flour beetle, Spider beetle

Chemical Control -

Active Ingredient	Rate	References
*Malathion	2% spray	4
*Pyrethrins + piperonyl butoxide	0.1% + 1.0%	10

*Apply at 5 L/100 m^2 to floor and lower half of walls of warehouses every 7 to 28 days during March-August.

Note: Malathion and pyrethrins are less effective on concrete than on wood surfaces (8). Pyrethrins generally breakdown quickly.

STORED GRAIN INSECTS AND MITES

Dermestid beetles, Foreign grain beetle, Fungus beetles, Granary weevil, Hairy spider beetle, Lesser mealworm, Meal moth, Psocid, Red flour beetle, Rusty grain beetle, Saw-toothed grain beetle, Storage mites.

Chemical Control - **EMPTY BIN SPRAYS**

Active Ingredient	Rate	References
+*Malathion - premium grade	1% or 2.5-3%	1,1A,4
*Pyrethrins + piperonyl butoxide	0.1% + 1.0%	10
Dichlorvos (DDVP-350)	16 g/2 L oil at 2 mL/m^3	1

* Apply 5 L/100 m^2 to floors and walls of empty, cleaned granaries.
+ In granaries to be used for rapeseed storage, apply malathion only to infested locations usually at floor and wall junctions (11,12).

Note: Malathion should be used 2-4 weeks before introducing grain. However, it may be used 1 day prior to storing grain. Dichlorvos is applied by thermal or mechanical fogger at ultra low volumes.

Diatomaceous Earth (Silicon Dioxide): a compound called "Insecto", (and others) which is 80% silicon dioxide has been registered for control of stored-grain insects in empty grain bins, silos, boxcars, and warehouses mainly as a crack and crevice treatment. The material provides a physical method of control. The recommended application rate is 500 g/100 m^2, in localized areas, which forms a relatively dense layer of dust.

WARNING: Repeated exposure to this fine dust may result in pulmonary disease. Silicon dioxide is registered for use on animal-feed grains and seeds, only, at 500 g/tonne seed.

PREVENTION OR CONTROL IN STORED WHEAT, OATS OR BARLEY

Active Ingredient	Rate	References
Malathion grain protectant		
0.5% dust	1.6 kg/tonne	5
1.0% dust	0.8 kg/tonne	-
2.0% dust	0.4 kg/tonne	-
Malathion - premium grade		
83.6% EC	10 mL in 0.5 - 0.8 L water/tonne	9

Note: Malathion is more effective in dry grain than in tough or damp grain where rapid breakdown occurs (5). The Canadian Grain Commission does not recommend the use of grain protectants (1). Cooling grain through aeration is the preferred management practice (7).

Restrictions -

Do not apply to grain within 7 days of selling for premium grade, deodorized grain protectant or 60 days for standard malathion grades (check label).

PREPARATION AND APPLICATION OF MALATHION

Prepare a 1% malathion spray from premium grade deodorized emulsifiable concentrate (83.6%) by using the following formula: (83.6-1)/1 = 82.6. Therefore, use 1 part of concentrate for every 82.6 parts of water (7).

Determine the flow rate of grain through the auger.

Use a pressurized sprayer or any other suitable applicator, such as a homemade drip device (3), to apply the 1% spray continuously to the grain stream as it is discharged from the spout or as it enters the auger tube.

Determine the rate at which the pressurized sprayer or other type of applicator discharges insecticide. A needle valve may have to be fitted to regulate the flow of spray from the nozzle of the sprayer or gravity flow applicator. For example, to treat 13.5 metric tons of wheat (500 bu.), 10.8 litres of 1% spray are needed. If it takes an hour to auger the grain, the sprayer must discharge the insecticide at 10.8/60 = 0.18 litres (6.3 fl oz) per minute.

Flow Rate (wheat)				Application Rate (spray)			
per hour		per minute		per hour		per minute	
tonnes	bushels	tonnes	bushels	litres	gallons	litres	gallons
3	110.4	0.050	1.84	2.4	0.54	0.04	0.009
6	220.2	0.100	3.67	4.8	1.08	0.08	0.018
9	330.6	0.150	5.51	7.2	1.56	0.12	0.026
12	441.0	0.200	7.35	9.6	2.10	0.16	0.035
15	551.2	0.250	9.19	12.0	2.88	0.20	0.048

FEEDING TREATED GRAIN TO LIVESTOCK

According to the Abell-Waco label, grain treated with 50% EC malathion applied at recommended rates, should not be fed to livestock for at least 2 months after treatment. According to the American Cyanamid label for Cythion, grain treated with formulations made from 83.6% or 50% premium-grade malathion should not be used as livestock feed for at least 60 days.

Note: Malathion resistance in stored-product insects is increasing in Canada (13). As of 1991 malathion will likely no longer be registered for use on grain in the U.S.A. because of residues and lack of interest by manufacturers to collect re-registration data.

FUMIGATION

Safety Measures Fumigants are poisons; take extreme precautions when they are used. Do not enter a structure that is under fumigation. Wait for at least 13 days before opening a farm structure that has been under fumigation. Most fumigants will have escaped by 5 days but a further 7 day waiting period is advised. Stay up-wind from the fumigant while the fumigant is added to grain going into the auger as a bin is being filled with grain.

Read the labels on the containers - Follow the manufacturer's recommendations. Wear protective clothing and gloves. A gas mask with a fresh canister should be used. Do not fumigate when the commodity is below 5°C.

Fumigation of Cereals -

Seal the grain bin as well as possible with caulking and masking tape before putting the infested grain in the bin -- leaks of fumigant gas reduce the effectiveness of the fumigation and present a hazard to people and animals immediately down-wind from the fumigated bin. Preferably, mix the fumigant with the infested grain as well as possible under the circumstances. To do this, add the fumigant to the grain as it is being augered into a bin. It may be necessary to transfer grain from one bin to another. Auger holes are a problem. Add some fumigant to the auger hole at the end of the fumigation -- and seal the door.

Chemical Control - Solid Fumigants*

Active Ingredient	Rate	References
Phosphine gas (Aluminum phosphide)	4 tablets or 8 pellets/m^3 grain ($1 m^3$ = 28 bushels)	1,2

*For all grains and oilseeds apply the tablets or pellets while augering the grain into a clean and well-caulked bin, wait 13 days before opening the storage structure. Use the entire volume of the bin, including the headspace, in dosage calculations.

The Canadian Grain Commission Inspectors' Manual entitled "Stored Grain Pests" provides the following temperature, dosage, and exposure time data for solid fumigants such as phosphine.

Grain Temperature (°C)	Minimum Exposure Period (Dosage per m^3)	Days
Above 20	4 tablets or 8 pellets	3
15-20	4 tablets or 8 pellets	4
11-14	5 tablets or 10 pellets	7
4-10*	5 tablets or 10 pellets	10

*Below 10°C, fumigation is not advisable in structures that are not air-tight.

After fumigation aerate all products at least 48 hours (i.e., open all doors and vents, and use aeration fans if available).

Carbon dioxide fumigation

Carbon dioxide gas is registered for insect control in stored grain. This method can be effective (14,15) but relatively air-tight storage structures are needed as is a commercial source for the compressed gas or dry ice. Extensive studies are under way to define conditions of use in Canada. The following concentration, time, and temperature conditions are suggested by the Canadian Grain Commission:

Grain Temperature (°C)	Minimum CO_2 level (%)	Days
40	60	1
25	60	5
20	60	14
10-20	60	14-56

Lower levels of CO_2 require longer exposures for complete eradication of pests.

WARNING: Atmospheres with high CO_2 levels are low in oxygen and cannot support life. (Gas masks used for pesticides will not give protection).

Turning Grain in Cold Weather

Auger 'heating' grain to another bin during winter. Several transfers may be needed to lower grain temperature to below freezing (6).

LESSER MEALWORM

Lesser Mealworms are occasionally found in grain and animal feed. Because they are relatively large, they are readily visible and therefore appear to be more serious than they actually are.

Chemical Control - Malathion or pyrethrins may be used to control these insect in grain; however, carbaryl (1A), tetrachlorovinphos (Disvap 50, Gardona), or Boric acid 98% (Darkling Beetle Dust; cracks and crevices), are registered for use against this species in poultry barns. Carbaryl may be applied to floors at a rate of 1.25 Kg. WP in 100 L of water.

FUNGUS BEETLES

Fungus beetles are controlled by the same treatments recommended for rusty grain beetles and other species associated with stored grain. However, these beetles do not feed on grain but rather on fungi associated with grain. Thus, their presence indicates that the grain is deteriorating. Although insecticide treatment will control the fungus beetles, it will not correct the underlying problem of deterioration. As soon as grain producers detect these beetles, they should immediately turn their grain to break up lumps of heating grain and if the moisture content exceeds 14.5% the grain should be dried or aerated before placing it back into storage.

Probe traps for insertion into stored grain to detect insects at low densities are extremely useful tools for grain managers (16,17) and can be purchased from Agrobiotech International, 35 Mount Allison Bay, Winnipeg, Manitoba, R3T 3L4 or from Trécé Inc., 1143 Madison Lane, Salinas, California.

References -

1. Anon., Stored Grain Pests Supplement to the Official Grain Inspectors' Manual. Can. Grain Comm. Winnipeg. 1989.

1A. Anon., Manitoba Agriculture. Insect Control Guide. 1988.

2. Monro, FAO Agr. Studies No. 79,381 pp. 1969.
3. Quinlan, White, Wilson, Davidson and Hendricks, J. Econ. Entomol. 72:90-93. 1979.
4. Tauthong and Watters, J. Econ. Entomol. 71:115-121. 1978.
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6. Watters, J. Econ. Entomol. 56:215-219. 1963.
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8. Watters, J. Econ. Entomol. 69:353-356. 1976.
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11. White and Abramson, J. Econ. Entomol. 77:289-293. 1984.
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13. White and Loschiavo, J. Econ. Entomol. 78:511-515. 1985.
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16. White et al., J. Kansas Entomol. Soc. 63:506-525. 1991.
17. Madrid, White and Loschiavo, Can. Entomol. 122:515-523. 1990.

HAZARDS AND SAFEGUARDS IN APPLYING INSECTICIDES TO CROPS IN BLOOM

J. Soroka and D. Murrell

CAUSES OF BEE POISONING

Most bee poisoning occurs when insecticides are applied to crops during the blooming period. Other Causes of bee poisoning are:

- drift of toxic sprays or dusts onto adjoining crops that are in bloom.
- bees coming into contact with insecticide residues on plants.
- bees drinking or touching contaminated water on foliage or flowers or from empty pesticide containers.
- bees collecting contaminated pollen or nectar .
- bees collecting unused pesticide dust or spray.

BEEKEEPER-GROWER CO-OPERATION

A major consideration for the reduction of bee poisoning is Beekeeper-grower co-operation. The beekeeper often depends on the grower for bee forage and the grower depends on the beekeeper for pollination. Co-operation and understanding of each other's problems are essential.

REDUCTION OF BEE POISONING

Reduction of bee poisoning: What The Pesticide Applicator Can Do

(1) Do not apply insecticides that are toxic to bees on crops or weeds in bloom.

(2) Apply certain chemicals only in late evening when bees are not actively foraging (see following table).

(3) Ground application is generally less hazardous than aerial application because there is less drift of the pesticides and smaller areas are treated at one time.

(4) Do not dump unused dusts or sprays where they might become a bee-poisoning hazard. Sometimes bees collect any type of fine dust material when pollen is not readily available. Under such conditions, they may actually carry pesticide dusts back to the colony.

(5) Use insecticides that are relatively non-hazardous to bees whenever such choices are consistent with other pest control considerations.

(6) Notify beekeepers in the area of your application plans at least 48 hours before applying hazardous pesticides.

What The Grower Can Do

(l) Learn the pollination requirements of the crops you raise. Application of insecticides hazardous to bees on these crops or driving beekeepers out of your area by the use of insecticides on other blossoming crops may contribute to poor yields.

(2) When insect pests have been damaging a crop every season, use a preventive program of monitoring and early season application before pest population increase, foliage growth, and weather conditions reduce the effectiveness of insecticides.

(3) Learn about the beekeeper's problems with chemical poisoning and enter into mutually advantageous agreements to produce bee-pollinated crops.

What The Beekeeper Can Do

(1) Give a map of apiary locations to your municipality office, extension agrologist, local aerial applicators, and the provincial apiculturist.

(2) Post your name, address, and phone number in printing large enough to be read at some distance in all apiaries so that you can be contacted readily to move the colonies when hazardous sprays are to be applied.

(3) If possible, choose apiary sites which are relatively isolated from intensive insecticide applications and which are not normally subjected to drift of chemicals.

(4) Cover honey bee colonies with plastic or tarpaulin to protect them from direct contact with insecticide during application.

SAFEGUARDING BEES

Safeguarding bees - If an insecticide has been applied to a crop to control pest insects and leafcutters are ready but have not been released, the incubator temperatures can be lowered to about 10°C and the bees held until the poisonous residue has disappeared from the crop (see following table). Shelters can be covered or closed during application of short-residual insecticides to prevent drift of

insecticides into shelters. In extreme northern areas bees may not get back to the shelters at night so evening application of insecticides is not advisable. Apply recommended insecticides during the bloom period after foraging has ceased on warm evenings only, to allow the bees good flight conditions to return to the shelters.

Do not apply insecticides to blooming crops or weeds. Do not allow insecticide dusts or sprays to drift onto bumble bee nest sites or bloom ng plants on which wild bees are foraging.

Field Application Hazard of Insecticides to Bees[a]

Insecticide	Hazard Rating[b] Honey Bee	Leafcutter Bee	Residue Hazard[c] (days)
acephate	1	1	2.5
aldicarb,soil granular	1	1	none
azinphos-methyl	1	1	5
Bacillus thuringiensis	3	3	none
bendiocarb	1	-[d]	-
carbaryl	1	1	3-7
carbaryl (Sevin XLR)	2	2	6
carbofuran F	1	1	3-5
carbofuran G	3	3	none
carbophenothion	2	2	1
chlorfenvinfos	3	-	-
chlorpyrifos	1	1	2-3.5
deltamethrin	2	2	1
demeton	2	2	1
diazinon	1	1	1-2
dichlorvos	1	1	-
dicofol	3	3	none
dimethoate	1	1	7
endosulfan	2	1	2
fensulfothion	1	-	-
fenthion	1	-	-
fenvalerate	1	1	1
fonofos	2	-	-
lindane	1	-	-
malathion EC	2	1	2 (6-LCB)
malathion D or ULV	1	1	-
methamidophos	1	1	1
methidathion	1	1	7
methomyl	1	1	1.5
methoxychlor EC	2	2	0.5
mevinphos	1	1	1-1.5
naled	1	1	1-1.5
oil sprays	2	-	-
oxydemeton methyl	2	2	0.5
permethrin	1	1	5
phosphamidon	1	1	2-5
pirimicarb	2	2	0.5
propoxur	1	1	-
pyrethrum	3	-	none
rotenone	3	-	none
tetradifon	3	2	0.5
trichlorfon	2	2	0.5

Notes:

[a] Most of these chemicals have not been tested for bee toxicity under Western Canadian conditions; the data herein are for a general guideline only.

[b] Hazard ratings for field application where bees are, or will be, foraging:

1. Very poisonous to bees; do not apply to crops or weeds in bloom unless bees are kept off for the period that residue on the crop is a hazard.
2. Moderately poisonous to bees; may be applied with minimum hazard in the evening when bees are not foraging.
3. Not very poisonous to bees; may be applied with minimum hazard to bees.

[c] Residue hazard represents the average time in days that residue poisonous to honey bees will remain on the foliage.

[d] No data available.

References -

1. Atkins et al., Reducing Pesticide Residues to Honey Bees, Univ. Calif., Leaflet No. 2883,1981.
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4. Johanson, How to Reduce Bee Poisoning from Pesticides, Wash. State Univ., Western Region Extension Publication No. 15, 1983.
5. Pesticide-pollinator interactions, Rept. Assoc. Comm. Sci. Crit. Environ. Qual., Nat. Res. Council Can., No. 18471, 1981.

APPENDIX I

1991

The following insecticides **WERE NOT REGISTERED** for these specific uses at the time this report was prepared (October 1990) but, otherwise, would be acceptable to the Committee at the rates indicated. However, these uses must not be recommended unless specified on registered product label.

Appendices I and II must not be copied if reproductions are made of the WCCP recommendations.

CEREAL CROPS AND GRAIN CORN

ARMYWORMS

Armyworms
Chemical Control -

Active Ingredient	Rate (g AI/ha)
Deltamethrin	7.5

Restrictions -
Deltamethrin: Do not use at temperatures above 25°C.

ORANGE WHEAT BLOSSOM MIDGE

Orange wheat blossom midge
Chemical Control -

Active Ingredient	Rate (g AI/ha)	Preharvest Interval	References
Endosulfan	400-560	-	-

OILSEED CROPS

CUTWORMS

Cutworms (sunflower)
Chemical Control -

Active Ingredient	Rate (g AI/ha)	References
Deltamethrin	10	1

References -

1. Catellier et al., Pest. Res. Rep. 1984.

FLEA BEETLES

Flea beetles (canola)
Chemical Control -

Active Ingredient	Rate	References
Isofenphos	12 g/kg seed	1,2
Endosulfan	560 g AI/ha	3
Cloethocarb (granular)*	280 g AI/ha	4,5,6

Note: * granules mixed with seed at time of planting

References -

1. Philip and Steiner, Pest. Res. Rep. 1979:206.
2. Westdal et al., Pest. Res. Rep. 1978:257; 1979:195, 200; 1980:112.
3. Wise, Pest. Res. Rep. 1983.
4. Lui, Pest. Res. Pep.1980:120.
5. Romanow & Askew, Pest. Res. Rep. 1982:86; 1983:85; 1984:101.
6. Westdal et al.,Pest. Res. Rep. 1980:112; 1981:110,114.

BEET WEBWORM

Beet Webworm (canola)
Chemical Control -

Active Ingredient	Rate	References
Deltamethrin	5.0 - 7.5	1,2

References -
1. Sonntag, Pest. Res. Rep. (In Press)
2. Harris, Pest. Res. Rep. (In Press)

FORAGE CROPS

PEA APHID

Pea aphid
Chemical Control -

Active Ingredient	Rate (g AI/ha)	Preharvest Interval	References
Deltamethrin	7.5-10		

GREENHOUSE VEGETABLE CROPS

THRIPS

Thrips - (cucumbers)
Chemical Control -

Active Ingredient	Rate	References
Deltamethrin	1.75 -2.5 g/100 L	1

Note: Some concern regarding possible increase in larval production with use of deltamethrin.

Reference -
1. Steiner, Pest. Res. Rep. 1985:203, 205.

BERRY CROPS

CHOKECHERRY FRUIT INSECTS

Chokecherry fruit insects
Chemical Control -

Active Ingredient	Rate	References
Acephate EC	25 mL/100 L	1
Diazinon EC	25 mL/100 L	1
Dimethoate EC	25 mL/100 L	1
Malathion EC	25 mL/100 L	1
Oxydemeton-methyl EC	25 mL/100 L	1
Propoxur EC	25 mL/100 L	1
Resmethrin	Follow label	1

Apply insecticide between start and end of petal fall. Controls both midge and sawfly. Phytotoxicity may occur with excessive application. Apply to blossoms as late as possible to avoid bee kill.

Restrictions -

Malathion: Do not apply at air temperatures below 20°C.

References -

1. Drouin and Kusch, NFRC, Edmonton, Inf. Rep. NOR-X-81, 1974; NOR-X-150, 1976; NOR-X-184, 1977; NOR-X-213, 1979.

LEAFROLLERS

Leafrollers on blueberries
Chemical Control -

Active Ingredient	Rate (g AI/ha)	Preharvest Interval	References
Deltamethrin	5.0-7.5	14 days	1

Restrictions -

Deltamethrin: Do not apply at air temperatures above 25°C.

References -

1. Raine, J. and Clements S.J., Pest Res. Rep. 1985:34.

SASKATOON FRUIT INSECTS

Saskatoon fruit insects
Chemical Control -

Active Ingredient	Rate	References
Acephate EC	25 mL/100 L	1
Diazinon EC	25 mL/100 L	1
Oxydemeton-methyl EC	25 mL/100 L	1
Permethrin EC	9.5 mL/100 L	1
Propoxur EC	25 mL/100 L	1
Trichlorfon 4 EC	25 mL/100 L	1

Apply insecticide between start and end of petal fall. Apply when most of the petals have fallen. Phytotoxicity may occur with excessive application. Apply as late as possible to avoid bee kill.

References -

1. Drouin and Kusch, NFRC, Edmonton, Inf. Rep. NOR-X-213, 1979; NOR-X-227, 1980.

SHELTERBELTS, ORNAMENTAL TREES AND SHRUBS

ASH BARK BEETLE

Ash bark beetle - three possible species
Chemical Control -

Active Ingredient	Rate	References
Carbaryl	2% solution in water	
Chlorpyrifos	0.5% solution in water	
Methoxychlor	4-12% solution in water	

NOTE: These are unregistered insecticides for ash bark beetle treatment and are suggested here for control of the adult stage. Apply solution to lower 0.5 m of mature ash trees in early September to reduce overwintering beetle populations. Though undocumented, the insecticides appear to control ash bark beetles similarly as for elm bark beetles.

ASH PLANT BUG

Ash plant bug
Chemical Control -

Active Ingredient	Rate	References
Diazinon EC	50 g/100 L	1
Deltamethrin EC.	1.1 g/100 L	2
Dimethoate EC	50 g/100 L	1

Apply to foliage when leaf damage first seen.

References -

1. Drouin and Kusch, NFRC, Edmonton, Inf. Rep. NOR-X-66, 1973; NOR-X-150,1976.
2. Reynard and Neill, PFRA, Indian Head, Pest. Res. Rep. 1985:207.

BLISTER BEETLES

Blister beetles
Chemical Control -

Active Ingredient	Rate	References
Malathion EC	50 g/100 L	1,2

Restrictions -

Malathion: Do not apply at air temperatures below 20°C.

References -

1. Howe, PFRA, Indian Head, unpubl. data, 1976.
2. Neill and Reynard PFRA, Indian Head Ann. Rep. 1985.

BOXELDER BUG

Boxelder bug
Chemical Control -

Active Ingredient	Rate	References
Cypermethrin EC	2.5 g/100 L	4
Diazinon	60 g/100 L	5
Dimethoate	50 g/100 L	1,5
Methoxychlor EC	50 g/100 L	1,2
Permethrin EC	6 g/100 L	3
Insecticidal Soap	1 kg/100 L	6

References -

1. Howe, PFRA, Indian Head, Ann. Rep., 1977.
2. Neill and Worden, PFRA, Indian Head, Ann. Rep. 1978.
3. Neill and Worden, PFRA, Indian Head, Ann. Rep. 1979.
4. Neill and Worden, PFRA, Indian Head, Ann. Rep. 1981.
5. Reynard and Neill, PFRA, Indian Head, Pest. Res. Rep.1988:162.
6. Reynard and Neill, PFRA, Indian Head, Pest. Res. Rep. 1989:151.

EUROPEAN FRUIT LECANIUM

European fruit lecanium

Chemical Control -

Active Ingredient	Rate	References
Diazinon EC	50 g/100 L	1
*Dutox EC	50 g/100 L	1

*Formulated, trichlorfon + oxydemeton-methyl. Apply to crawler stage after 15 July.

References -

1. Drouin and Kusch, NFRC, Edmonton, Inf. Rep. NOR-X-184, 1977.

CARPENTER WORM & ASH BORER

Carpenter worm & Ash borer

Chemical Control -

Active Ingredient	Rate	References
Diazinon	0.6 g/L	1
Carbaryl	3.0 g/L	1

On high value trees locate gallery entrances marked by fresh boring frass in spring. Apply 2.5 ml into each hole with an eye dropper.

References -

1. Solomon, J. Econ. Entomol. 78;485-488,1985

LEAF BEETLES

Leaf beetles - Elm, poplar and willow feeding species

Chemical Control -

Active Ingredient	Rate	References
Dimethoate EC	50 g/100 L	-
Malathion EC	50 g/100 L	1,2
Methoxychlor EC	50 g/100 L	1

Restrictions -

Dimethoate: May be phytotoxic to *Amelanchier, Prunus*, and *Ulmus* spp.
Malathion: Do not apply at air temperatures below 20°C.

References -

1. Howe, PFRA, Indian Head, Ann. Rep., 1976.
2. Neill & Reynard, PFRA, Indian Head, Pest Res. Rep. 1985:209.

LEAF MINERS

Leaf miners on poplar

Chemical Control -

Active Ingredient	Rate	References
Carbaryl (WP)	0.5-1.6 g/L	-
Acephate	25 g/100 L	-
Diazinon	50 g/100 L	-

Apply insecticide in late May or early June, similarly as for birch leaf miner

MOUNTAIN PINE BEETLE

Pre-emergence treatment for control of Mountain pine beetle in single trees or small tree groupings.

Chemical Control -

Active Ingredient	Rate	References
Chlorpyrifos	1-2% solution	1
Carbaryl	1-2% solution	1

Apply 1 L of mixture/sq meter of bark surface to height of 2-4 meters or to a height where the diameter is about 12 cm. Apply in early July to the point of run off to all sides of the stem.

References -

1. Fuchs and Borden, J. Econ. Entomol. 1985.

PEAR SLUG

Pear slug
Chemical Control -

Active Ingredient	Rate	References
Dimethoate EC	5.6 g/cm stem diam.	1

Apply as soil drench in early July; water in well.

References -

1. Drouin and Kusch, NFRC, Edmonton, Inf. Rep. NOR-X-131, 1975; NOR-X-150,1976; NOR-X-205,1978.

ROSE CURCULIO

Rose curculio
Chemical Control -

Active Ingredient	Rate	References
Carbaryl	1.25-1.6 g/L	-

Cultural Control -

Adults can be hand picked during morning sunny periods.

RUSTY TUSSOCK MOTH

Rusty tussock moth
Chemical Control -

Active Ingredient	Rate	References
Diazinon EC	50 g/100 L	1

SAWFLIES

Sawflies - open-feeding defoliators on currant, larch, pines, spruces and willow

Chemical Control -

Active Ingredient	Rate	References
Dimethoate	Follow label	1,2
Fenvalerate EC	25 g/100 L	1
Methoxychlor EC	50 g/100 L	1
Resmethrin	0.25% pressurized spray	1

Apply to foliage when young larvae first seen.

References -

1. Drouin and Kusch, NFRC, Edmonton, Inf. Rep. NOR-X-81, 1974; NOR-X-131, 1975; NOR-X-150, 1976; NOR-X-184, 1977; NOR-X-205, 1978; NOR-X-213, 1979.
2. Howe, PFRA, Indian Head, Ann. Rep., 1976.

SPIDER MITES

Spider mites (on spruce, larch, cedar and juniper)

Chemical Control -

Active Ingredient	Rate	References
Dimethoate EC	50 g/100 L	2
Omite WP	10 g/L	1
Pirimor WP	50 g/100 L	1

Apply as foliar sprays about mid-July.

References -

1. Drouin and Kusch, NFRC, Edmonton, Inf. Rep. NOR-X-150,1975; NOR-X-213, 1979; NOR-X-227,1980.
2. Neill and Reynard, PFRA, Indian Head, Ann. Rep., 1984.

SPINY ELM CATERPILLAR

Spiny Elm Caterpillar

Chemical Control -

Active Ingredient	Rate	References
Diazinon EC	50 g/100 L	1

SPRING CANKERWORM

Spring Cankerworm
Chemical Control -

Active Ingredient	Rate	References
deltamethrin	0.045 g/100 L	1

References-

1. Reynard and Neill, PFRA, Indian Head, Pest. Res. Rep. 1988:164.

TERMINAL WEEVILS

Terminal weevils (spruce and pine)
Chemical Control -

Active Ingredient	Rate	References
Methoxychlor EC	2-3% solution	1,2

Spray leaders of open-planted trees less than 6 m tall about mid-May.

References -

1. Sundaranm et al., CCRI, Ottawa, Inf. Rep. CC-X-31,1972.
2. Turner et al., Ont. Min. Nat. Res., Publ. PC-3,1975.

UGLY-NEST CATERPILLAR

Ugly-nest caterpillar
Chemical Control -

Active Ingredient	Rate	References
Dimethoate EC	50 g/100 L	1
*Dutox EC	50 g/100 L	1

*Formulated, trichlorfon + oxydemeton-methyl. Apply in April to overwintered egg clusters.

References -

1. Drouin and Kusch, NFRC, Edmonton, Inf. Rep. NOR-X-150, 1976.

WARREN ROOTCOLLAR WEEVIL

Warren Rootcollar Weevil

Chemical Control -

Active Ingredient	Rate	References
Dimethoate	ll g/cm stem diam.	l

Apply as soil drench and watered in well.

References -

l. Drouin and Kusch, NFRC, Edmonton, Inf. Rep. NOR-X-131,1975; NOR-X-205,1978.

WILLOW RED GALL SAWFLY

Willow red gall sawfly

Chemical Control -

Active Ingredient	Rate	References
Carbaryl (WP)	1.25 g/L	l

Spray willows 3 days after first emergence of adults, about mid to late May, and repeat l0 days later. Monitor for adults with yellow sticky traps (l).

References -

1. Neill & Reynard, PFRA, Indian Head, Ann. Rep., 1983.

APPENDIX II

Appendix II contains Temporary Registered and Registered insecticides that, in the opinion of the committee, require more efficacy data.

CEREAL CROPS

ARMYWORM

Armyworm
Chemical Control -

Active Ingredient	Rate (g AI/ha)	Preharvest Interval
Chlorpyrifos	420-580	60

EUROPEAN CORN BORER

European corn borer
Chemical Control -

Active Ingredient	Rate (g AI/ha)	Preharvest Interval
Carbofuran (FL) (Grain & silage corn)	530	7
Chlorpyrifos (Grain corn)	1120	70
Deltamethrin (Grain corn)	12.5-17.5	1
Permethrin (G) (Grain corn)	100	N/A

Restrictions -

Carbofuran: Do not apply more than four times per season. Do not apply within seven days of harvest. Cobs, husks, and stalks may then be fed to livestock.

Deltamethrin: Do not allow beef cattle to graze treated fields within 1 day of application. Do not feed treated silage to dairy cattle. Do not allow dairy cattle to graze deltamethrin treated fields.

GRASSHOPPERS

Grasshoppers
Chemical Control -

Active Ingredient	Rate (g AI/ha)	Preharvest Interval
Azinphos-methyl	275-425	30
Deltamethrin (2.5 F.), aerial application	4	
Methamidophos	550	10

Restrictions -

Deltamethrin: Do not graze on treated fields. Do not make more than three applications per year (only two applications per year by air). Do not apply at temperatures above 25°C. Best control is obtained if application is made when the grasshoppers are in the 2-4 nymphal stage.

RUSSIAN WHEAT APHID

Russian wheat aphid
Chemical Control -

Active Ingredient	Rate (g AI/ha)	Preharvest Interval
Chlorpyrifos	480	60
Dimethoate	210	2
Malathion	700	7

WIREWORMS

Wireworms
Chemical Control -

Active Ingredient	Rate (g AI/ha)
Fonofos G	
Broadcast	4450
Band	1130-1460

Restrictions -

Fonofos: Check label for rates for various row spacings.

OILSEED CROPS

BERTHA ARMYWORM

Bertha armyworm
Chemical Control -

Active Ingredient	Rate (g AI/ha)	Preharvest Interval
Cypermethrin	50-70	30

Restrictions -
Cypermethrin: Avoid application at temperatures above 27°C. (Only one application by air).

DIAMONDBACK MOTH

Diamondback moth
Chemical Control -

Active Ingredient	Rate (g AI/ha)	Preharvest Interval	References
Chlorpyrifos	500-575	21	1

References -
1. Jurus, Pest. Res. Rep. 1985.

GRASSHOPPERS

Grasshoppers
Chemical Control -

Active Ingredient	Rate (g AI/ha)	Preharvest Interval
Chlorpyrifos	280-420	21

FORAGE CROPS

PEA APHID

Pea aphid in alfalfa
Chemical Control -

Active Ingredient	Rate (g AI/ha)	Preharvest Interval
Demeton	275	21
Oxydemeton-methyl	425-550	-

Restrictions - Oxydemeton-methyl: Do not pasture or use crop for feed.

COMMERCIAL VEGETABLE CROPS

EUROPEAN CORN BORER

European corn borer
Chemical Control -

Active Ingredient	Rate (g AI/ha)	Preharvest Interval
Carbofuran	530	7
Permethrin (G)	100	-

Granules to be applied to the leaf axils.

ONION MAGGOT

Onion maggot
Chemical Control -

Active Ingredient	Rate (g AI/ha)	Preharvest Interval
Chlorpyrifos (in the furrow at planting)		
Onion, dry	2.5 g/100 m row	141
Onion, pickling	2.5 g/100 m row	97

GREENHOUSE ORNAMENTALS

APHIDS

Aphids
Chemical Control -

Active Ingredient	Rate (g AI/ha)	Preharvest Interval
Bendiocarb (Trumpet)	60-80	1

Restrictions -
Allow 24 hours after treatment before re-entering treated areas. Gloves should be worn when ~~working~~ with treated foliage.

MEALYBUGS

Mealybugs
Chemical Control -

Active Ingredient	Rate (g AI/ha)	Preharvest Interval
Bendiocarb (Trumpet)	60-80	14

Restrictions -
Allow 24 hours after treatment before re-entering treated areas. Gloves should be worn when working with treated foliage.

WHITEFLIES

Whiteflies
Chemical Control -

Active Ingredient	Rate (g AI/ha)	Preharvest Interval
Bendiocarb (Trumpet)	60-80	14

Restrictions -
Allow 24 hours after treatment before re-entering treated areas. Gloves should be worn when working with treated foliage.

SHELTERBELTS, ORNAMENTAL TREES AND SHRUBS

ASH BORER

Ash borer

Chemical Control -

Active Ingredient	Rate
*Chlorpyrifos EC	500 g/100 L
Endosulfan EC + ethion EC	45 + 23 g/100 L

Spray stems about 21 May and again mid-June.

*Note: Chlorpyrifos: commercial use only; apply to infested limb and trunk for control of ash borer and lilac borer.

APPENDIX III

CROSS REFERENCE INDEX OF COMMON NAMES OF COMPOUNDS USED IN THIS REPORT AND THEIR ASSOCIATED TRADE NAMES

acephate ..... ORTHENE
AFUGAN ..... pyrazophos
aldicarb ..... TEMIK
ALLETHRIN ..... pyrethrins
ALTOSID ..... methoprene
AMBUSH ..... permethrin
AMMO ..... cypermethrin
APM ..... azinphos-methyl
ATOX ..... rotenone
azinphos-methyl ..... APM, GUTHION

Bacillus thuringiensis ..... DIPEL, ENVIROBAC, NOVABAC, THURICIDE
BASUDIN ..... diazinon
BAYGON ..... propoxur
BELMARK ..... fenvalerate
bendiocarb ..... FICAM, TRUMPET
BIRLANE ..... chlorfenvinphos
boric acid ..... DARKLING BEETLE DUST
BRIQUETS ..... methoprene
BUTOCIDE ..... piperonyl butoxide

carbaryl ..... SEVIN
carbofuran ..... FURADAN
chlorfenvinphos ..... BIRLANE
chlorpyrifos ..... LORSBAN, DURSBAN
CINERIN ..... pyrethrins
cloethocarb ..... LANCE
COUNTER ..... terbufos
CYGON ..... dimethoate
cyhexatin ..... PLICTRAN
CYMBUSH ..... cypermethrin
cypermethrin ..... RIPCORD, AMMO, CYMBUSH
CYTHION ..... malathion

DARKLING BEETLE DUST ..... boric acid
DASANIT ..... fensulfothion
DDVP ..... dichlorvos
DECIS ..... deltamethrin
Deltamethrin ..... DECIS
Demeton ..... SYSTOX
DERITOX ..... rotenone

diatomaceous earth ..... INSECTO
diazinon ..... BASUDIN, DIAZINON, SPECTRACIDE
DIBROM ..... naled
dichlorvos ..... DDVP, VAPONA
dicofol ..... KELTHANE
dienchlor ..... PENTAC, SATHON
dimethoate ..... CYGON, ROGOR, SYS-TEM, HOPPER-SPRAY,
..... HOPPER-KILL, HOPPER-TOX, HOPPER STOPPER
DIPEL ..... *Bacillus thuringiensis*
DISVAP ..... tetrachlorovinphos
disulfoton ..... DI-SYSTON
DI-SYSTON ..... disulfoton dormant oil
..... dormant oil
DRIONE ..... silica gel
DURSBAN ..... chlorpyrifos
DUTOX ..... trichlorphon + oxydementon-methyl
DYFONATE ..... fonofos
DYLOX ..... trichlorfon

endosulfan ..... THIODAN ,THIONEX
ENVIROBAC ..... *Bacillus thuringiensis*
ethion ..... ETHION

fenbutatin-oxide ..... TORQUE, VENDEX
fensulfothion ..... DASANIT
fenvalerate ..... BELMARK
FICAM ..... bendiocarb
fonofos ..... DYFONATE
FURADAN ..... carbofuran

GAMMA BHC ..... lindane
GAMMA HCH ..... lindane
GARDONA ..... tetrachlorovinphos
GUTHION ..... azinphos-methyl

HOPPER-KILL ..... dimethoate
HOPPER-SPRAY ..... dimethoate
HOPPER STOPPER ..... dimethoate
HOPPER-TOX ..... dimethoate

IMIDAN ..... phosmet
INSECT SMOKE FUMIGANT ..... sulfotep
insecticidal soap ..... SAFER'S INSECTICIDAL SOAP
INSECTO ..... diatomaceous earth
isofenphos ..... OFTANOL

JASMOLIN ..... pyrethrins

KELTHANE ..... dicofol

LANCE ..... cloethocarb
LANNATE ..... methomyl
lindane ..... GAMMA BHC, GAMMA HCH
LORSBAN ..... chlorpyrifos

malathion ..... CYTHION
MARLATE ..... methoxychlor
MESUROL ..... methiocarb
metaldehyde ..... SLUG BAIT, SNAIL BAIT
METASYSTOX-R ..... oxydemeton-methyl
methamidophos ..... MONITOR
methidathion ..... SUPRACIDE
methiocarb ..... MESUROL
methomyl ..... LANNATE
methoprene ..... ALTOSID, BRIQUETS
METHOXOL ..... methoxychlor
methoxychlor ..... MARLATE, METHOXOL, METHOXYCHLOR
mevinphos ..... PHOSDRIN
MONITOR ..... methamidophos
MULTIPURPOSE TETRALITE ..... resmethrin

N-propanol ..... N-propanol
naled ..... DIBROM
NICOTINE SULFATE ..... 1,2-nicotine sulfate
NO-MOLT ..... teflubenzuron
NOVABAC ..... *Bacillus thuringiensis*

OFTANOL ..... isofenphos
OMITE ..... propargite
ORTHENE ..... acephate
oxydemeton-methyl ..... METASYSTOX-R

parathion ..... PARATHION
PENTAC ..... dienochlor
permethrin ..... AMBUSH, POUNCE
phorate ..... THIMET
PHOSDRIN ..... mevinphos
phosmet ..... IMIDAN
phosphine ..... PHOSTOXIN
PHOSTOXIN ..... phosphine
piperonyl butoxide ..... BUTOCIDE
pirimicarb ..... PIRIMOR
PIRIMOR ..... pirimicarb
PLANTFUME 103 ..... sulfotep
PLICTRAN ..... cyhexatin
POUNCE ..... permethrin

propargite ..... OMITE
propoxur ..... BAYGON
pyrazophos ..... AFUGAN
PYRETHRIN ..... pyrethrins
pyrethrins ..... CINERIN, JASMOLIN, PYRETHRIN, ALLETHRIN

resmethrin ..... MULTIPURPOSE TETRALITE
RIPCORD ..... cypremethrin
ROGOR ..... dimethoate
Rotenone ..... ATOX, DERITOX, ROTENONE

SAFER'S INSECTICIDAL SOAP ..... insecticidal soap
SATHON ..... dienochlor
SBP-1382 ..... resmethrin
SEVIN ..... carbaryl
silica gel ..... DRIONE
SLUG BAIT ..... metaldehyde
SNAIL BAIT ..... metaldehyde
SPECTRACIDE ..... diazinon
sulfotep ..... PLANTFUME 103, INSECT SMOKE FUMIGANT
SUPRACIDE ..... methidathion
SYS-TEM ..... dimethoate
SYSTOX ..... demeton

TEDION ..... tetradifon
teflubenzuron ..... NO-MOLT
TEMIK ..... aldicarb
terbufos ..... COUNTER
tetrachlorovinphos ..... DISVAP, GARDONA
tetradifon ..... TEDION
THIMET ..... phorate
THIODAN ..... endosulfan
THIONEX ..... endosulfan
THURICIDE ..... *Bacillus thuringiensis*
TORQUE ..... fenbutatin-oxide
trichlorfon ..... DYLOX, TRICHLORPHON
trichlorfon + oxydemeton-methyl ..... DUTOX
TRUMPET ..... bendiocarb

VAPONA ..... dichlorvos
VENDEX ..... fenbutatin-oxide

APPENDIX IV

SUBCOMMITTEES FOR 1991

Cereal crops and grain corn	O. Olfert, D.L. Johnson
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Forage crops	B.D. Schaber, M. Okuda
Special crops	J.W. Jones, W.J. Turnock
Household pests	M. Steiner, L. Harris
Home vegetable crops	L. Harris
Commercial vegetable crops	R.S. Vernon, J. McCullough
Greenhouse crops	M. Steiner, J. McCullough
Interior plantscapes and house plants.	M. Steiner, J. McCullough
Mushrooms	R.S. Vernon
Berry crops	H. Gerber, R.S. Vernon
Shelterbelts, ornamental trees & shrubs	G.B. Neill, H.F. Cerezke
Seasoned wood and timber structures	H.F. Cerezke
Turf	M. Dolinski
Warehouse and farm-stored grain	N.D.G. White
Bee safety	J. Soroka, D. Murrell

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GUIDELINES FOR ADDITIONS OR REVISIONS TO THE WCCP GUIDE

The following guidelines are suggested for making submissions for additions or revisions to the WCCP guide.

1. Submissions to be forwarded to the appropriate subcommittee chairman or the subcommittee chairman would approach companies for data to support additions by September 15.

2. Subcommittee reviews submissions using the following criteria.

   (a) Product and use must be registered under the PCP Act.
   (b) Experimental data in support of the submission, to be obtained from laboratory and Western Canadian field evaluations with induced and/or natural infestations, conducted according to acceptable research practices regarding replication, reproducibility, checks and standards comparability, statistical design and analyses, and interpretation of results.

   (c) Documented references, either published or not.

   Note: Criteria would not necessarily apply to additions or revisions to Household Pests, Greenhouse Ornamentals and Turf Sections.

APPENDICES

1. Products that are not registered but are proven effective as per criterium 2, may be included in Appendix I.

2. Products that are registered but require more data on performance may be included in Appendix II.

3. Subcommittee Chairman recommends acceptance or rejection of submission to WCCP.

4. Western Committee on Crop Pests accepts or rejects recommendation.

Committee: Harvey Craig, Bill Charnetski, Ed Thiessen,
Mike Dolinski, Dave Smith